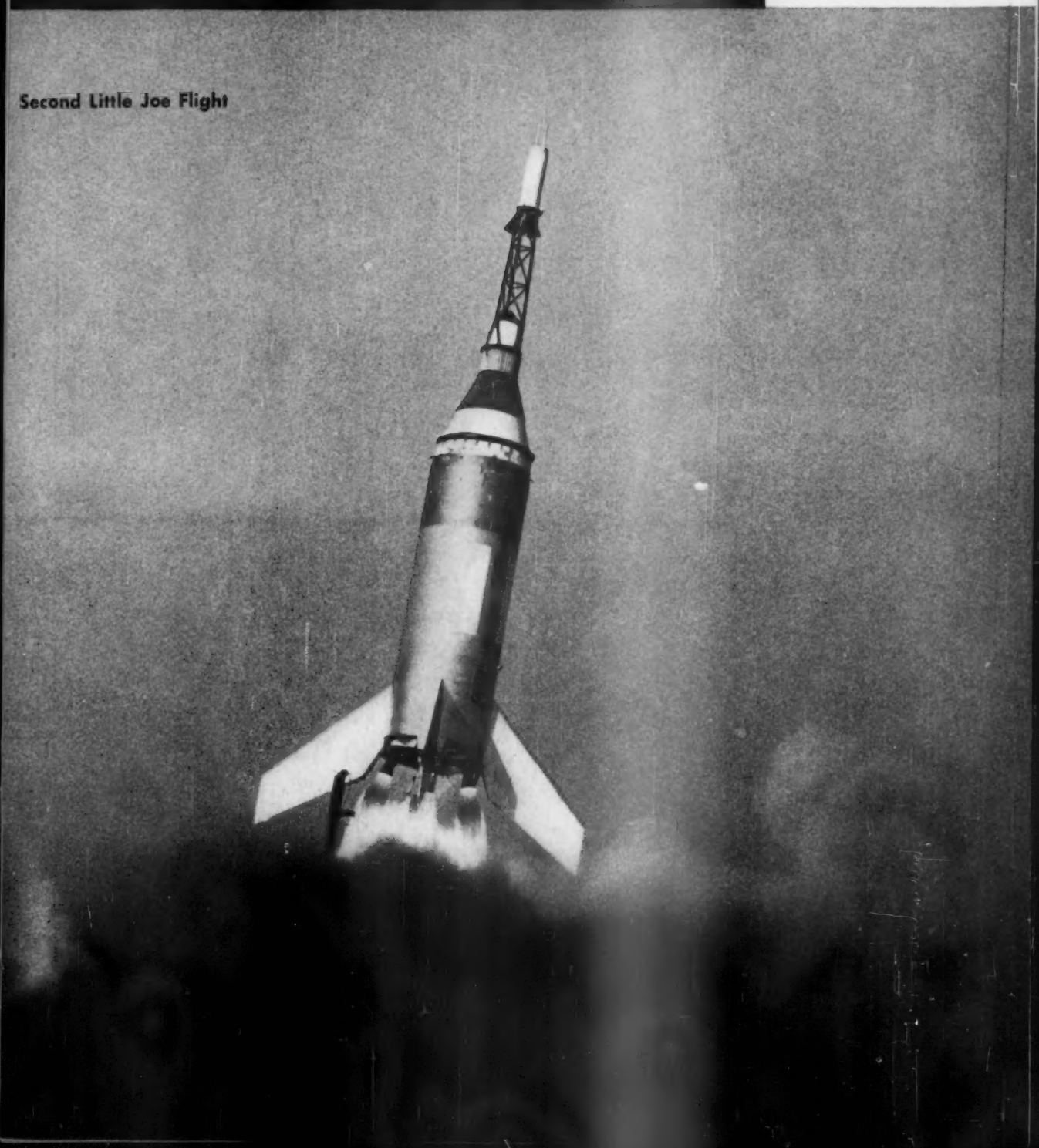
November 16, 1959

Aviation Week

Including Space Technology

Okanagan Pilots Fly Mountain, Bush Missions



Second Little Joe Flight

CONVAIR'S F-106 DELTA DARTS - ALL-WEATHER INTERCEPTORS

SILHOUETTES OF STRENGTH

Now entering full-scale operational status with the U.S.A.F. Air Defense Command, Convair's F-106 is the world's fastest and highest-flying all-weather interceptor. These "silhouettes of strength," latest and most spectacular of the delta-shaped interceptors pioneered by Convair, a Division of General Dynamics Corporation, are playing a vital part in helping the Air Defense Command in its mission of protecting your home and country!

A DIVISION OF **GENERAL DYNAMICS CORPORATION**

CONSIDER...

Products shown are twice actual size

Lockheed for electronic ceramics

The research, development and manufacture of miniature electronic ceramic components is centered in the new Electronic Ceramics Laboratory at Lockheed Electronics and Avionics Division (LEAD).

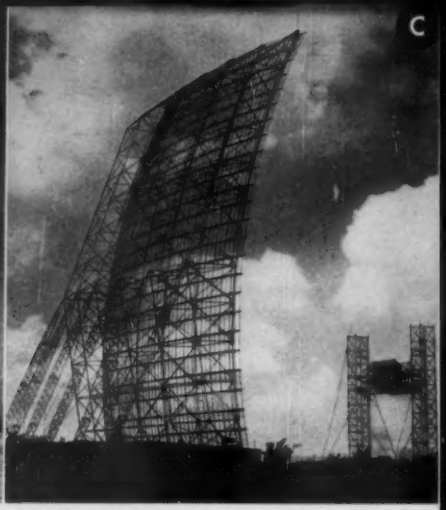
This facility is fully able to provide electronic ceramics to meet your particular specifications: MEMORY CORES, a whole family of square loop cores to suit computer and shift register applications: MULTI-APERTURE DEVICES (MAD), Cavitron equipment for the volume production of any geometry of MAD; RECORDING HEADS, of very dense materials with high flux density ground to a micro-finish; GARNETS, poly-crystalline yttrium-iron garnets with minimum line width and loss tangent; ALUMINA SUBSTRATES, of high mechanical strength, high electrical resistivity and low dielectric loss; CUP CORES, in any size to specified inductance and minimum temperature coefficient; HIGH "Q" MATERIALS, for use as inductors, tuning slugs, transformers—frequency ranges from 1 to 50 megacycles.

What are your requirements? Write... Marketing Branch, 6201 E. Randolph Street, Los Angeles 22, California. Telephone OVerbrook 5-7070.

Look to Lockheed for LEADership *in Electronics*

LOCKHEED ELECTRONICS & AVIONICS DIVISION

Requirements exist for staff and supervisory engineers



ANTENNA PROBLEMS?

ASK KENNEDY!

A TRACKING ANTENNAS — *A 60-foot satellite tracker points skyward. 28- and 84-foot models also available.*

B SCATTER ANTENNAS — *One end of a scatter link showing two 120-foot antennas. 28- and 60-foot models are also available.*

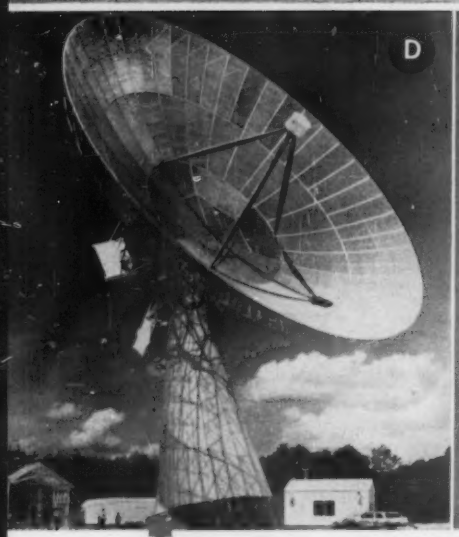
C RADAR ANTENNAS — *A giant radar antenna forerunner to the BMEWS Program. Dozens of conventional types are also available.*

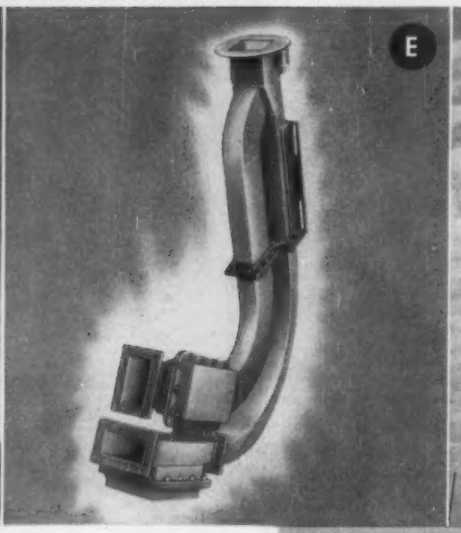
D RADIO TELESCOPES — *An 84-foot radio telescope listens to the heavens whisper. 28- and 60-foot models are also available.*

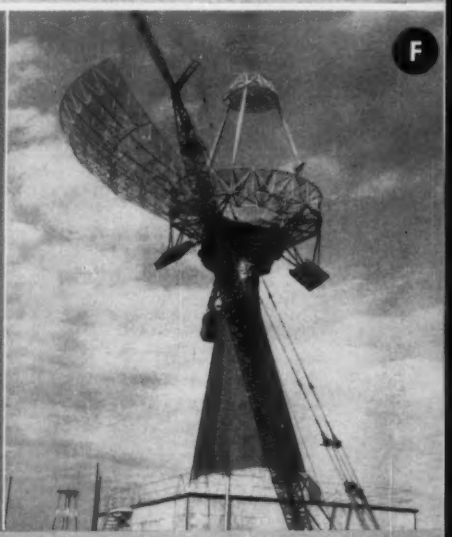
E WAVEGUIDE COMPONENTS — *A dual polarized feed with two waveguide inputs. Other large size components include many types of horns, duplexers, transitions, straight sections and bends.*

F FIELD SERVICE — *Kennedy Field Service engineers erect an 84-foot radio telescope. Other services include site selection, construction, personnel training and servicing.*

G RESEARCH AND DEVELOPMENT — *Kennedy's antenna service includes basic R & D in microwave propagation.*







THE solution to antenna problems begins when someone says: "Let's ask Kennedy!"

A few of the many reasons why are shown on this page. These Kennedy antennas are setting new standards for all-weather reliability and versatility wherever they serve throughout the free world.

Kennedy antennas come in many shapes and many sizes. But whatever the type, and whatever the conditions under which it must serve, Kennedy can offer a design that fully measures up to specifications.

Kennedy Field Service engineers are available to install antennas anywhere in the world. It's a part of the complete, integrated service that is still another reason why more and more people in electronics are "asking Kennedy" about antenna problems.

ANTENNA EQUIPMENT

D. S. KENNEDY & CO.

COHASSET, MASSACHUSETTS EVergreen 3-1200

West Coast Affiliate . . .

SATELLITE KENNEDY, INC. of CALIFORNIA

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Down-to-earth SOLUTIONS *to out-of-this-world* PROBLEMS

Tracking Antennas-Radio Telescopes-Radar Antennas

"Trans-Horizon" Antennas-Tropospheric Scatter

Ionospheric Scatter

AVIATION CALENDAR

Nov. 23-24—Symposium on Solid Facts about Solid State, Instrument Society of America, Ben Franklin Hotel, Philadelphia, Pa.

Nov. 30-Dec. 4—Fourth Annual Naval Air Weapons Meet, Operation "Top Gun," Marine Corps Auxiliary Air Station, Yuma, Ariz.

Nov. 30-Dec. 4—First industry and government-wide training course in Value Engineering & Analysis, Industrial Education Institute, Boston, Mass.

Nov. 30-Dec. 4—Annual Meeting, American Society of Mechanical Engineers, Chalfonte and Haddon Hall Hotels, Atlantic City, N. J.

Dec. 1-3—Eastern Joint Computer Conference, Statler Hilton Hotel, Boston, Mass. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Association for Computing Machinery.

Dec. 6-9—52nd Annual Meeting, American Institute of Chemical Engineers, Sheraton-Palace, San Francisco, Calif.

Dec. 7-8—Classified symposium on "The Plasma Sheath, Its Effect on Communication and Detection," Boston, Mass. Sponsor: Electronics Research Directorate, Air Force Cambridge Research Center.

Dec. 7-11—National Conference on the Application of Electrical Insulation, Sheraton-Park Hotel, Washington, D. C. Sponsors: American Institute of Electrical Engineers; National Electrical Manufacturers Assn.

Dec. 8-9—First Aerospace Finishing Symposium, Hotel Texas, Fort Worth, Tex. Sponsors: Society of Aircraft Materials and Process Engineers; Dallas-Fort Worth Branch of the American Electroplaters Society.

Dec. 17—23rd Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C. Dr. Alexander

(*Continued on page 6*)

AVIATION WEEK Including Space Technology
November 16, 1959
Vol. 71, No. 20

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Precision production of jet engine components is a job for specialists. Broader use of jet-propulsion in helicopters, missiles and drones puts new demands on the high performance small jet engine . . . and on the precision workmanship required in the manufacture of its parts. "Hot end" components must withstand high stresses and temperatures . . . require exacting fabrication, welding, machining and inspection . . . to close dimensional tolerances.

Lavelle specializes in producing precision sheet metal engine components. Combustion chambers, casings, exhaust nozzles and housings are typical parts produced in quantity for principal turbojet and turboprop engine manufacturers. They depend on Lavelle's experience and facilities for quality workmanship, dependable delivery . . . at reasonable cost.

An illustrated brochure details Lavelle's ability to produce the precision aircraft components you need . . . when you need them. Write for your copy today.

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Designed especially for High Strength—High Temperature and liquid oxygen and other corrosive applications, Cherry Aircraft Lockbolts* are now available in austenitic A-286 Stainless Steel.

Available for the aircraft industry in a wide range of diameters, grip lengths and head styles in A-286 . . . Cherry Lockbolts are also produced in Alloy Steel and Aluminum.

Cherry Lockbolts are structural fasteners providing simplicity and speed of installation with uniform high tensile preloads.

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ESTABLISHED 1816 • NEW BRIGHTON, PA.

AVIATION CALENDAR

(*Continued from page 5*)

H. Flax, chief Air Force scientist, will speak on "High Temperatures in Hypersonic Flow—Physical Principles and Experimental Techniques." Dr. Flax will repeat his lecture on Dec. 18 before the IAS Cleveland Section, on Dec. 21 before the IAS Los Angeles Section, and Dec. 22 before the IAS Texas Section.

Dec. 26-30—Sixth King Orange International Model Plane Meet, Miami, Fla.

Jan. 11-13—Sixth National Symposium on Reliability and Quality Control in Electronics, Statler-Hilton Hotel, Washington, D. C.

Jan. 12-16—16th Annual Technical Conference, Society of Plastics Engineers, Conrad Hilton Hotel, Chicago, Ill.

Jan. 14-20—Sixth Annual Meeting, American Astronautical Society, Statler-Hilton Hotel, New York, N. Y.

Jan. 25-28—28th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 26.

Jan. 28-29—Solid Propellants Conference, American Rocket Society, Princeton University, Princeton, N. J.

Feb. 3-4—Sixth Annual Midwest Welding Conference, Illinois Tech Chemistry Bldg., Chicago, Ill. Sponsors: Armour Research Foundation of Illinois Institute of Technology; Chicago Section, American Welding Society.

Feb. 3-5—1960 Winter Convention on Military Electronics, Institute of Radio Engineers, Ambassador Hotel, Los Angeles.

Feb. 10-12—Seventh Annual Solid-State Circuits Conference, Philadelphia, Pa. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; University of Pennsylvania.

Mar. 10-11—National Flight Propulsion Meeting (classified), Institute of the Aeronautical Sciences, Cleveland, Ohio.

Apr. 6-8—Structural Design of Space Vehicles Conference, Biltmore Hotel, Santa Barbara, Calif. Sponsor: American Rocket Society's Structures and Materials Committee.

Apr. 6-8—1960 National Meeting "Hyper-Environments—Space Frontier," Institute of Environmental Sciences, Biltmore Hotel, Los Angeles, Calif.

Apr. 19-21—International Symposium on Active Networks and Feedback Systems, Engineering Societies Bldg., New York, N. Y. Sponsors: Polytechnic Institute of Brooklyn; Department of Defense Research Agencies; Institute of Radio Engineers.

Apr. 20-22 — National Symposium on Manned Space Stations, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsors: National Aeronautics and Space Administration; the Rand Corp.

Apr. 21-22—Southwest Metals & Minerals Conference "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Apr. 27-28—National Meeting on Space Age Materials, Cincinnati Chapter of the American Society for Metals, Sheraton Gibson Hotel, Cincinnati, Ohio.

FROM LAGRANGIAN TO LIFT-OFF

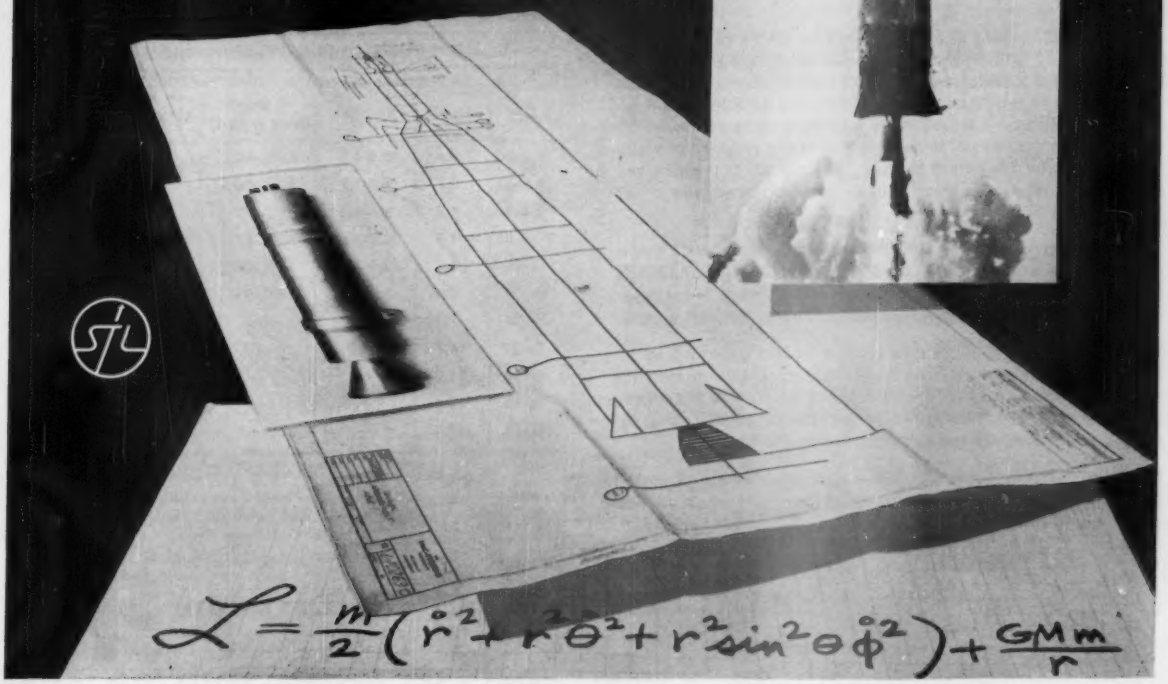
Sometimes forgotten during the thundering ascent of a space probe rocket are months of meticulous analysis, engineering and planning. The staff of Space Technology Laboratories is now engaged in a broad program of space research for the Air Force, the National Aeronautics and Space Administration and the Advanced Research Projects Agency under the direction of the Air Force Ballistic Missile Division. For space probe projects STL provides the total concept approach, including preliminary analysis, sub-system development, design, fabrication, testing, launch operations and data evaluation. The total task requires subtle original analysis in many fields as well as sound technical management.

The STL technical staff brings to this space research the talents which have provided system engineering and technical direction since 1954 to the Air Force Ballistic Missile Program. Major missile systems currently in this program are Atlas, Titan, Thor and Minuteman.

The scope of STL's responsibilities offers creative engineers, physicists and mathematicians unusual opportunities to see their ideas tested in working hardware. Inquiries are invited regarding staff openings in the areas of Advanced Systems Analysis, Rocket Propulsion, Space Flight Mechanics, Dynamics, Structural Analysis, and Aerodynamics.

Space Technology Laboratories, Inc.

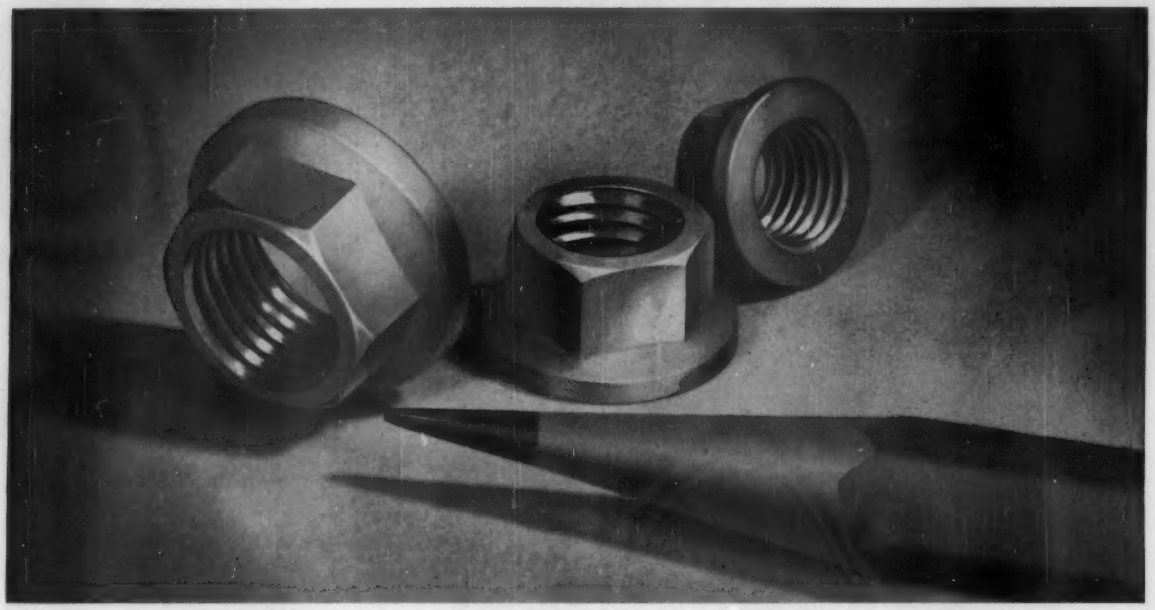
P. O. Box 95004, Los Angeles 45, California



SPS RELIABILITY / *A dynamic standard of predictable performance*

Meets new NAS 1291

SPS FN-12 Featherweight locknut replaces NAS 679 and equivalents*—saves up to 72% in locknut weight



SPS FN-12 Series Featherweight locknut was the first to meet new NAS 1291 calling for a lighter weight replacement for NAS 679 sheet metal nuts. New forged featherweight offers major weight savings, superior performance, high reliability; also permits secondary weight reductions through use of narrower bolting flanges.

Here is one of the few nuts that meet new NAS 1291 standard calling for a lighter weight locknut interchangeable with NAS 679 sheet metal nuts. The new SPS FN-12 weighs 12-60% less than its NAS 679 counterparts . . . and 12-72% less than equivalent MS or AN types. Yet it sacrifices none of the static or dynamic properties of these larger, heavier nuts. It provides 160,000 psi tensile strength on a 180,000 psi bolt and gives greater bolt tension-tension fatigue strength than any other lightweight locknut tested.

The FN-12 saves weight in another way also. Because of its new configuration, it can be installed closer to vertical bulkheads than any other aircraft nut now in use. This allows a narrower bolting flange, with consequent reductions in aircraft weight.

You can specify FN-12 Series Featherweight locknuts in 11 sizes—#4 through 5/8 inch. All sizes are available for immediate delivery. From #4 to 5/16", FN-12 locknut prices are practically the same as NAS 679 locknuts. In the size range including 3/8" and above, prices are considerably lower.

For more information, write SPS—manufacturer of precision threaded fasteners and allied products in many metals, including titanium. Request Bulletin 2426.

ACTUAL WEIGHTS OF FN-12 AND COMPARABLE LOCKNUTS

All Weights Expressed as Pounds per 1000 Pieces

Size	FN-12	NAS 679†	% Weight Saved by FN-12	AN Series‡	% Weight Saved by FN-12
#4-40	0.4	0.8-1.0	50%-60%	1.3	69%
#6-32	0.7	1.3-1.7	50%-60%	2.5	72%
#8-32	1.2	2.1-2.5	43%-52%	4.2	71%
#10-32	1.5	2.5-2.8	40%-47%	4.6	67%
1/4-28	3.5	3.9-4.7	12%-26%	8.5	59%
5/16-24	5.4	6.4-7.2	16%-25%	11.8	54%
3/8-24	7.3	9.3	21%	19.5	63%
7/16-20	14.7	16.0	8%	22.6	35%
1/2-20	21.0	—	—	43.5	51%
9/16-18	24.4	—	—	71.5	66%
5/8-18	33.8	—	—	87.3	61%

†Range of four most commonly used sheet metal nuts of NAS 679 type
‡Range for AN 363, 364, 365

•MS 20364, MS 20365; NAS 1021, NAS 1022; AN 363, AN 364, AN 365 and AN Plain Nuts

AIRCRAFT/MISSILE Division SPS

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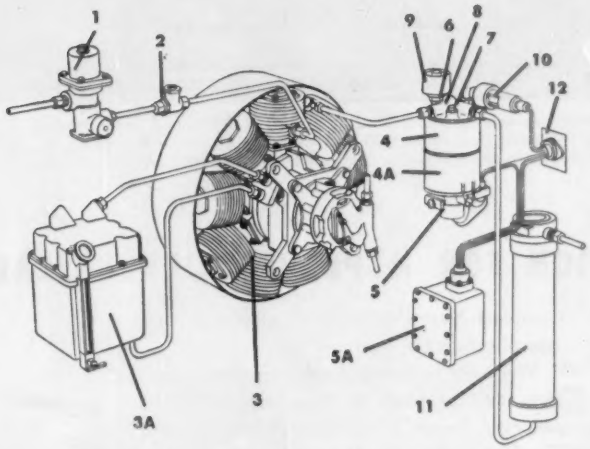
. . . important news about

JET STARTING

Cornelius 309 compressor "package." 9 cylinders, 8 to 10 CFM, 3000 psi. This one compact unit includes all of the components named in the schematic drawing (below left).

for reliable "split-second" jet starting equip your jets with Cornelius compressors



1. Absolute Pressure Regulator 2. Vacuum Breaker 3. Air Compressor with Hydraulic or Electric Motor 3A. Oil Reservoir 4. Moisture Separator 4A. Thermostatically Controlled Heater Blanket 5. Condensate Dump Valve 5A. Condensate Exhaust Timer and Relay 6. Check Valve 7. Back Pressure Valve 8. Switch Rupture Disc 9. System Relief Valve 10. Pressure Switch 11. Chemical Drier 12. AC-DC Power Input

The Cornelius 309 compressor "package" will soon be operational on five major domestic airlines and five major foreign airlines. It has also been selected for installation on the Allison Prop-Jet Super Convair. This pneumatic system was developed to give jets better, faster starts. It is unmatched for reliability, capacity and longer life. It improves the performance of any jet or prop-jet equipped with a fuel-air starting system.

Here are some facts that demonstrate Cornelius equipment superiority: The 309 compressor is the largest capacity compressor now in production and flying. Its 8 to 10 CFM air delivery is 50 per cent greater than any other available compressor. This larger CFM delivery means greater reliability and longer life because less "ON" time is required for air reservoir recovery; is ideal for short flights.

Specify Cornelius as original equipment. Whether you are an airline or an airframe manufacturer, you are guaranteed to receive a compressor package that is the last word in design and performance — a compressor *second-to-none.*

For *retrofit* programs, replace your small, less reliable compressors with Cornelius 309 compressors. There's a 309 package for every application and it will reduce your maintenance, overhaul and operating costs.

For complete information, qualification test data and installation drawings, contact us today.

THE Cornelius COMPANY / *Aero Division*

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Pioneers in pneumatic systems for aircraft.

Above: Nose cone test shape traveling at 5,500 feet per second photographed with Avco Schlieren System at 0.05 μsec exposure. Inset: Avco Kerr Cell. Permits exposure from 0.005 to 0.1 μsec; available as an independent module.

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Write for bulletins describing Avco's products and systems in the fields of Hypervelocity Instrumentation, Major Research Facilities and Environmental Test Equipment. *Write to: Products and Services Dept., Research and Advanced Development Division, Avco Corporation, 201 Lowell Street, Wilmington, Mass.*

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TESTS RPM ACCURACY to 10 RPM in 10,000 RPM (±0.1%).

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ASSURES... *maximum range, lower operating costs, greater dependability of schedule operation, better assurance of on-time arrivals at planned destinations!*

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THE ALOUETTE SAVES REGULARLY...

ON EVERY MISSION

In transporting, hauling, spraying, aerial inspection, construction work, stringing wire, or at nearly any job, the turbine-powered ALOUETTE II — operating in heat or cold, at high or low altitudes — SAVES DOLLARS.

PROOF: Check these facts:

- ✻ *An Alouette sprayed an acre of brush along a remote powerline right of way in only 20 seconds for $7.26*
- ✻ *An Alouette transported four surveyors 20 miles to a 9,000 foot mountain landing at a total cost per man of $12.50*
- ✻ *An Alouette lifted and carried a 900 lb. seismographic drill rig 2 miles for $5.00*
- ✻ *An Alouette strung 8,000 feet of ⅜ inch steel cable in 1 hour and 40 minutes for $210.00*
- ✻ *An Alouette erected 30 telephone poles in 1 hour and 10 minutes at a total cost of $175.00*

Regardless of the task or climate . . . the low-maintenance Alouette brings ECONOMY to helicopter operations. Contact Republic's Helicopter Division for complete details on any of the above missions and on how the Alouette can help fill your needs.

*Designed by Sud Aviation

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NLS SERIES 20

When the combination of reliability, speed and accuracy is of uncompromising importance—you can't afford to gamble on "second best" digital measuring equipment! NLS Series 20 instruments are field-proven in the most critical applications—missile and electronic systems checkout, automatic process monitoring, sophisticated laboratory research. Be sure—specify NLS Series 20, the instruments selected by major missile manufacturers after thousands of hours of competitive life testing.

Features: M24 measures DC voltage, voltage ratio or resistance in a third of a second, V24 measures DC voltage and voltage ratio at same speed . . . both instruments feature advanced transistorized circuitry and mercury-wetted relays with life in excess of 3 billion readings . . . ±one digit accuracy on DC voltage and voltage ratio . . . completely automatic operation . . . plug-in modular construction . . . AC or low level measurements with plug-in accessories . . . output connectors for continuous data logging, remote ranging. Ranges: DC voltage ±.0001 to ±999.9; DC voltage ratio to ±.9999; resistance .1 ohm to 1 megohm. Write today for complete data.

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NLS—The Digital Voltmeter That Works . . . And Works . . . And Works!

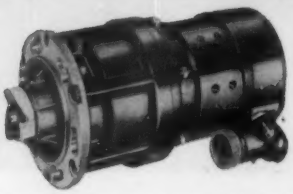
J&H helps the Caribou* climb out of rough fields and short runways

DeHavilland's Caribou cargo and personnel transport is designed for use under less-than-ideal field conditions . . . answering many needs in both military and commercial aviation. These special flying requirements demand rugged, precision equipment that does not impose weight and space penalties. DeHavilland chose J&H components because they fulfilled requirements exactly and were in the production stage—proven and ready to fly.

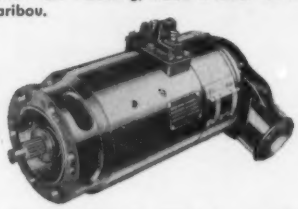
Jack & Heintz can satisfy your system and component needs, no matter how specialized, with aviation's most extensive lineup of electric power systems and components.

Write to: Jack & Heintz, Inc., 17635 Broadway, Cleveland 1, Ohio.

**Both military and commercial versions.*



JH6BFSR3 Starter's d-c motor has excellent torque characteristics. This, together with machine's rugged clutch and convenient button-hole mounting, made it ideal for the Caribou.



G300-4B Generator selected for its superior low-speed operating characteristics. Starter-generator versions of this machine are also available.

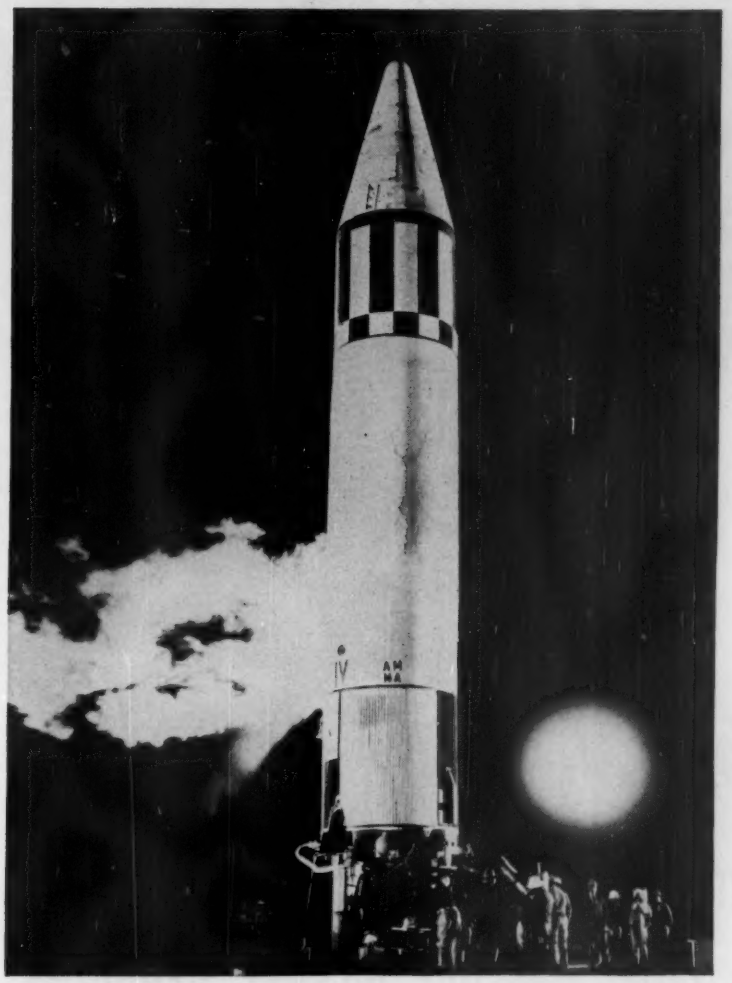
GC34-2 Control Panel selected for compactness, and convenient installation and maintenance. Versions of this panel serve starter-generator applications.

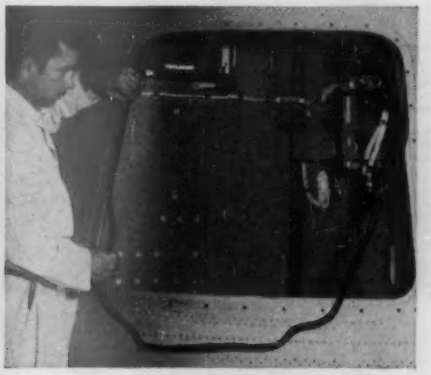
JACK & HEINTZ, Inc.

SYSTEMS FOR AIRCRAFT, MISSILES AND GROUND SUPPORT

SILICONE NEWS from Dow Corning

Sealing Zero...and 500 F





Silastic was specified for the Jupiter's instrument compartment access door seal. The Silastic seal has better storage properties and can better stand high skin temperatures. Wire bundle clamps in the compartment also utilize Silastic.

In the cooling system for Jupiter's instrument compartment, low pressure liquid nitrogen vapor is carried by these ducts. Made of Silastic and glass cloth, they're light in weight, and are designed to meet specs of —75 to 600 F performance.

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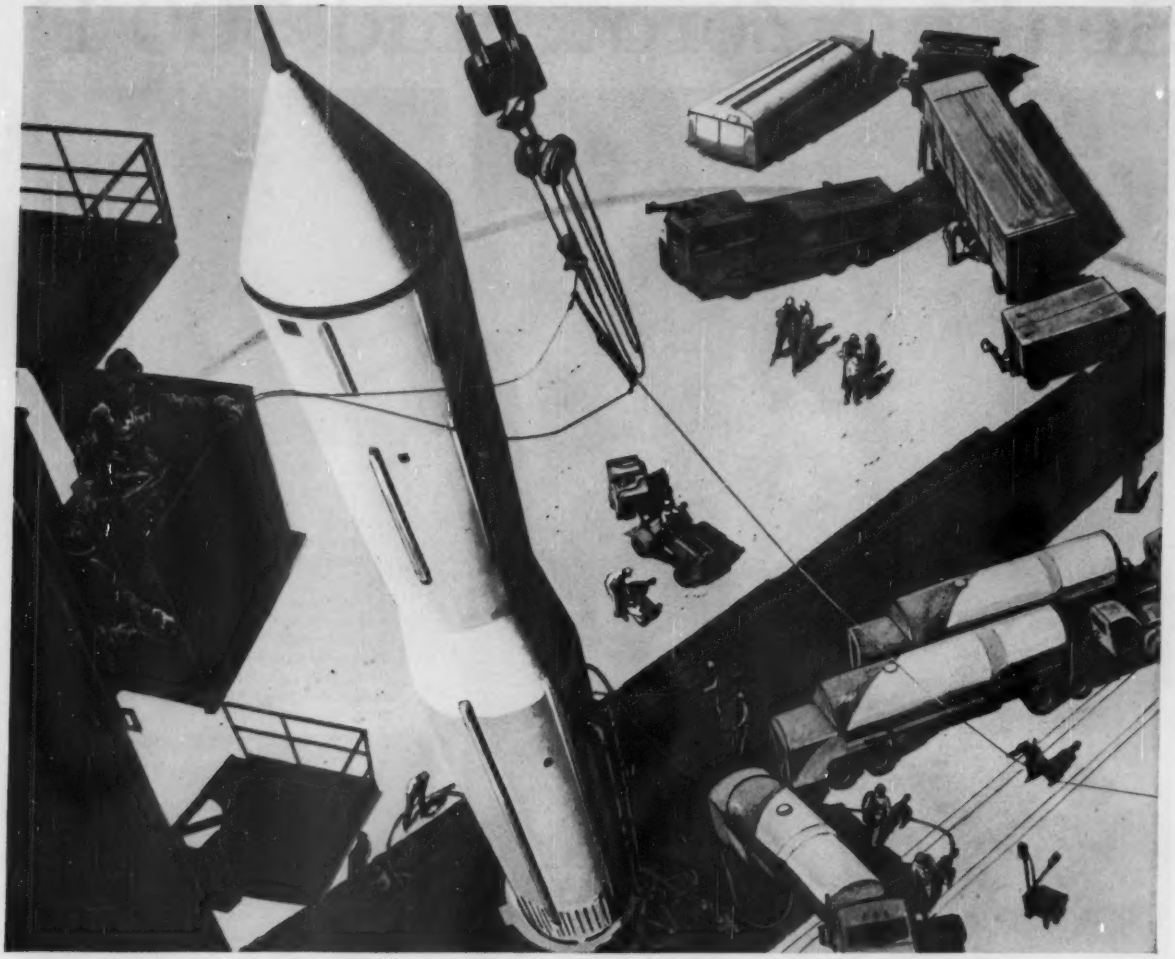

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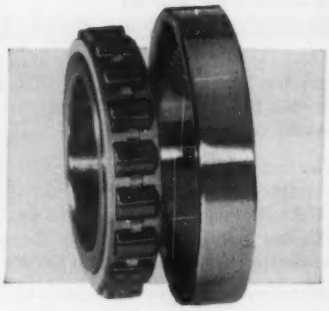

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November 16, 1959

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COVER: Little Joe test vehicle launches Mercury capsule from Wallops Island, Va., in successful test of pilot escape system under maximum dynamic loads (AW Nov. 9, p. 29). National Aeronautics and Space Administration vehicle carried capsule to 33,000 ft. There, escape rockets on 16-ft. tower attached to capsule fired, carrying capsule to 35,000 ft. and away from launch rocket. Flight simulated most severe conditions under which capsule will have to escape from Atlas booster in case of malfunction during orbital flight attempts. Capsule was recovered by ship (see p. 31). Firing was the third attempt to launch capsule with Little Joe. Two were successful. First shot aborted when escape rockets fired prematurely.

PICTURE CREDITS

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EDITORIAL

Thoughts on Disarmament

Since the visit of Nikita Khrushchev to this country there has been considerable talk in Moscow and Washington of disarmament as a prelude to establishing lasting peace in the world. Genuine peace, of course, is an almost universal goal among people if not always of governments. But, throughout our history as a nation, there have been times and places where we decided that the price of peace was too high to pay if we desired to survive as a free nation—at Lexington, Ft. Sumter, Pearl Harbor and the 38th parallel of Korea to name a few.

In the current diplomatic trend to look on swift disarmament as a panacea that will solve all world problems, it is worth taking time to mull over some of the more realistic questions raised by this sudden interest in disarmament by a nation that has devoted the last 15 years to one of the most extensive technical armament programs the world has ever seen and whose avowed aim is to bring all other countries of the world under the iron yoke of its political system.

Perhaps part of the answer lies in some of the domestic problems facing Mr. Khrushchev in the Soviet Union. According to the best available estimates, the USSR has been devoting about 40 to 45% of its gross national product to its defense industry, technology and armed forces. This crushing economic burden has prevented any substantial improvement in the Soviet citizen's standard of living. Since the first holes were poked in the Iron Curtain after Stalin's death, the Soviet citizen has been getting more and more of an idea of how the rest of the world lives. This has generated tremendous domestic pressure for major improvements in the standard of living which can only be met by reductions in the Soviet armament programs.

The expanding Soviet economy is also beginning to feel the pinch of labor shortages caused by the low birth rate during the terrible war years. Already the educational program has been shortened to pour more youths into the factories and farms sooner. Demobilization of several million infantrymen would also ease this increasing labor shortage.

Also, the Soviets either now have achieved or think they have achieved military parity with the United States. Hence, they feel they can negotiate from a position of strength rather than from their acknowledged position of military inferiority some five years ago.

Some economists studying the disarmament problem point out that, while the present Soviet program consumes about 40% of its gross national product and is a severe limitation on expansion of its normal economy, the United States is supporting its defense program with only about 9% of its gross national product and without any strain on one of the most prosperous economies in the history of the world. They raise the question as to whether it is in the best interests of the United States to provide the Soviet Union with the economic breathing spell it so desperately needs or whether the best tactic would be to double our own defense program and set a pace that it would be impossible for the Soviets to match. This would soon relegate them to another position of acknowledged inferiority and take considerable starch out of their current stiff position.

There also is a tendency to link the cause of disarmament with economy and a general feeling that a disarmament program will eliminate a vast area of government spending and tax burdens. Is this really a valid assumption? Do the people who have been studying the technical phases of the monitoring, reconnaissance and inspection systems required to realistically police any disarmament program find that they differ substantially from the costs of current defense programs? How much of a net economic gain is possible without sacrificing an effective control and surveillance system?

Another point that has been thrown into sharp focus by the recent independent actions of France in the Western bloc and China in the Communist bloc is how effective any disarmament agreement between the United States and the USSR would really be in enforcing world peace? Both France and China have indicated they are perfectly willing to defy the leaders of their respective political blocs and pursue independent nationalistic policies in regard to nuclear weapons and foreign aggression. Is a disarmament program that cannot effectively control the mavericks of any practical use?

Then, too, in the last analysis what really effective penalties can be enforced against a violator of a disarmament agreement short of actual war? We have seen a long history of disarmament pacts, attempts at economic sanctions, etc., in the decades between the two World Wars and the more recent postwar decade, but they seem to have had little effect until the use of force became the final effective policy. In all this modern history of disarmament pacts, they have only served to provide a potential aggressor with the time required to build sufficient strength to violate the agreement with impunity, while the nations who abided by the agreement in good faith let their military power to enforce it dwindle away.

The cause of peace is certainly one of humanity's shining goals, and the motives impelling many world leaders to seek methods of effective disarmament are unquestionably sincere. But too many of us can still recall the triumphant arrival at Croydon Airport of a trusting British gentleman clutching an umbrella and waving a piece of paper which he announced he had brought from Munich to ensure "peace in our time." That, as we all remember, was just a year before the Nazi Panzers and Stukas ground Poland into the dust and forced free men everywhere to fight for their lives and countries for five bitter years. Before we become too firmly committed to any proposals aimed at reducing our military strength or that of our allies, we should make certain that some of these realistic considerations have been thoroughly appreciated. In the meantime, any unilateral move to diminish our military posture and to lower our defense guard would be sheer folly.

—Robert Hotz

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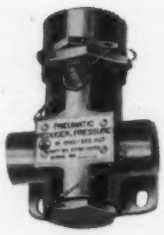

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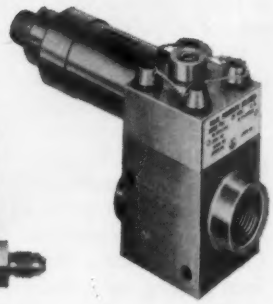

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James R. Day, a director, Radio Engineering Laboratories, Inc., Long Island City, N. Y., a subsidiary of Dynamics Corporation of America. Mr. Day is a vice president of REL.

Norman C. Pickering, a director, Avien, Inc., Woodside, N. Y. Mr. Pickering continues as vice president and technical director.

Maurice Hughett, vice president and general manager, Cook Electric Co.'s Technological Center, Morton Grove, Ill.

Robert F. Halligan, executive vice president and general manager, The Hallicrafters Co., Chicago, Ill.

Albert J. Morris, senior vice president-engineering, Levinthal Electronic Products, Inc., Palo Alto, Calif., a subsidiary of Radiation, Inc. Also: **Harry G. Heard,** chief engineer.

George M. Ebert, vice president and general manager of the newly-organized Aerocal Division of Aeronca Manufacturing Corp., Middletown, Ohio. The new division integrates Aeronca's facilities in Los Angeles and Torrance, Calif.

John H. Mahoney, vice president of marketing services, Capital Airlines, Inc.

John Michelotti, vice president-manufacturing, Clearing Division of U. S. Industries, Inc., Chicago, Ill.

Joseph C. Duke, executive vice president for sales administration and public relations, Minnesota Mining & Manufacturing Co., St. Paul, Minn. **C. C. March** succeeds Mr. Duke as executive vice president for the Coated Abrasives, Adhesives and Chemicals Division. Also: **J. F. Whitcomb,** general manager, Coated Abrasives Division.

Ivar C. Peterson, assistant to the president, Lear, Inc., Los Angeles, Calif., to direct and supervise technical planning.

Lufthansa German Airlines has named **Georg Stoecker** as general manager for North and Central America, replacing **Wolfgang A. Kittel** who is now a member of the airline's four-man board of chief executives.

Rear Adm. John S. Thach has received orders for duty in the Office of the Chief of Naval Operations. **Rear Adm. John E. Clark** will relieve Adm. Thach as commander of Carrier Division 16.

Honors and Elections

Louis A. Person, director of traffic for Braniff Airways, has been elected chairman of the International Air Transport Assn.'s Traffic Conference for 1960. **Joseph R. Horton,** director of maintenance and engineering for Braniff, has been appointed chairman of the Air Transport Assn.'s Engineering and Maintenance Conference for 1960.

Wing Cmdr. E. W. Anderson of Sperry Gyroscope Company, Ltd., has been elected president of The Institute of Navigation, London, England.

(Continued on page 147)

INDUSTRY OBSERVER

► Project Transit navigation satellite being handled by Navy for the Advanced Research Projects Agency is being designed to give Polaris submarines a position fix to an accuracy of one-tenth of a mile by the time the system becomes operational in the 1962-63 period. Special equipment will be required to determine the location with that accuracy, but ordinary vessels without this equipment will be able to fix position with one-half mile accuracies.

► **Rocket engine backup effort in USAF's Minuteman solid propellant ballistic missile program will be reviewed by the end of the year to determine the feasibility of using a single contractor for development of the second and third stage powerplants. Thiokol at present is the only first stage contractor; Thiokol and Aerojet have parallel programs for the second stage, with each stressing a different approach, and Aerojet has third stage responsibility with a limited backup by Thiokol. Hercules Powder Co. research on double-based propellants for the system probably will be continued.**

► Research and analysis of a mobile ballistic missile system is being conducted by the Planning Research Corp., Los Angeles, for Air Force's Ballistic Missile Division. Scheduled for completion by the end of the year, the study is concerned with developing the fundamental relationships concerning the military and economic value of mobility as a basic mode of operation.

► **Prototype flight test of Aerojet's SD-2X surveillance drone is scheduled for February at Army's Yuma, Ariz., site. The SD-2X, a follow-on version of the former Rheem SD-2, will feature an infrared sensor and transmission system to relay photographs directly to the ground rather than depend on film recovery. Drone speed of the recoverable vehicle will exceed 300 kt.**

► Northrop's Norair Division is investigating a broad field of VTOL and STOL combat and logistics-type aircraft in a company-funded study.

► **Third-stage, 6,000-lb.-thrust storable propellant rocket motor under development by Jet Propulsion Laboratory for National Aeronautics and Space Administration's Vega research vehicle has been fired successfully on two occasions from the D-stand at Edwards AFB, Calif. Rocket motor uses hydrazine and nitrogen tetroxide.**

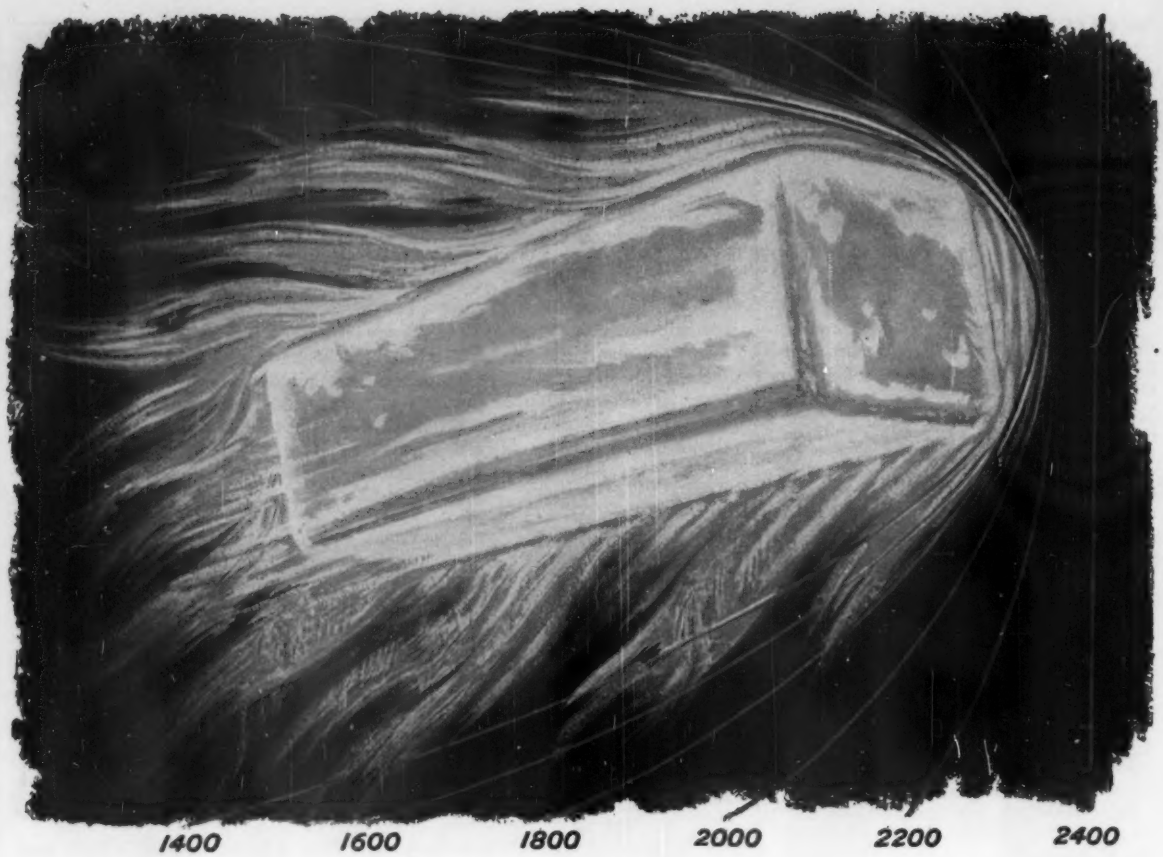
► Commanders of the Atlantic, Pacific and White Sands missile ranges met recently at USAF Missile Test Center, Patrick AFB, Fla., to decide what support they will be able to offer NASA in the Project Mercury man-in-space program. Range functions for orbital Mercury flights will be coordinated on a world-wide basis by Maj. Gen. Donald Yates, AFMTC commander (AW Oct. 5, p. 26).

► **Special facilities are being erected at Palm Bay, Fla., by Radiation, Inc., for development of a high-accuracy pulse-code modulated telemetering system for testing North American Aviation's guidance system scheduled for Air Force's Minuteman intercontinental ballistic missile. Radiation, Inc., is constructing the facilities under subcontract to Boeing Airplane Co., assembly and test contractor for Minuteman.**

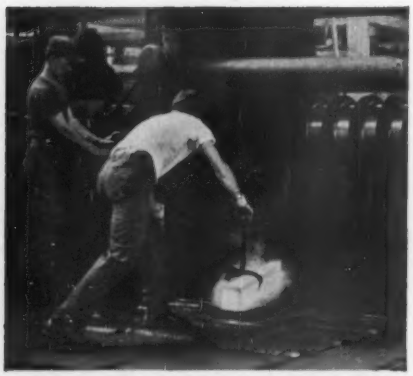
► Sparrow III missiles incorporating Thiokol storable liquid propellant engines (AW Nov. 2, p. 34) are now being introduced to the fleet in limited quantities. Powerplant, replacing the solid propellant originally designed for the missile, eventually will be used in virtually all operational versions of the Sparrow III.

► **Altitude chamber testing of NASA's Mercury capsule controlled environment system has begun at Garrett Corp.'s AiResearch Division in Los Angeles.**

► Communist China has begun mass production of the single rotor Whirlwind 25 helicopter. The vehicle is a close copy of the Russian Mil Mi-4.



Bending the Heat Barrier



Specialized mill equipment is available at HAYNES STELLITE for rolling high-temperature alloys into a variety of shapes and sizes. Bar (above) is being produced on a 24-inch mill.

High strength plus resistance to oxidation, creep, thermal shock, and fatigue—are some of the properties that have helped to push the heat barrier back over the past 15 years. These are the properties found in HAYNES high-temperature alloys. Properties that make these alloys very useful in the 1000 to 2000+ deg. F. range.

Typical uses? The really hot spots in jet aircraft, ramjets, and missiles are some. Furnace components, heat-treating equipment, kiln liners are others. In fact, any part where long service life under severe high-temperature conditions is essential.

There are 12 HAYNES high-temperature alloys—available immediately in convenient forms that can be readily fabricated. For information on properties and prices, write for descriptive literature.

HAYNES
ALLOYS

HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

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Washington Roundup

Space Budget Boost

Watch for a substantial increase in the Fiscal 1961 budget for the national space research program to be proposed to Congress by President Eisenhower. Twin pressures of the series of successful Soviet moon probes and a dogged fight by top leaders of the National Aeronautics and Space Administration have convinced the White House and Budget Bureau of the acute need for adequate funding of the expanding U.S. technical capability in space research and the necessity for attempting to gain world leadership in this area. NASA budget for Fiscal 1960 was $500,780,000 after congressional cuts. Budget to be proposed to Congress for Fiscal 1961 probably will be close to $800 million.

Fairchild Stock Activity

Financial circles are curious about heavy acquisitions of Fairchild Engine & Airplane Corp. stock by Washington lawyer C. Leo DeOrsey. DeOrsey joined the Fairchild board last March after he acquired 15,000 shares. Securities and Exchange Commission reports late this summer showed his holdings had risen to 35,000 shares, and, in the last few weeks, his holdings have grown to 60,000 shares. The only other larger individual stockholder is Board Chairman Sherman Fairchild, who last spring held 100,559 shares. Speculation is that DeOrsey is acting for entertainer Arthur Godfrey, whom he has represented previously.

Last week, Fairchild turned up on the most active list of stocks traded on the New York Stock Exchange with a turnover of 27,300 shares in one day, and the stock had gained $1 in price.

U. S.-Canadian Meeting

Details of shipping and storing nuclear warheads in Canada under joint U.S.-Canadian control were discussed last week at a cabinet-level meeting between representatives of the two countries. Warheads will be available in 1961 for use in Canadian-built Boeing Bomarc air defense missiles.

Discussions also covered disarmament and a further strengthening of the defense sharing policy which was increased about six months ago. Under this policy, Canadian purchases of defense equipment in the U.S. would be balanced dollarwise by U.S. buying in Canada. To strengthen the present loose arrangement, the Canadians made a specific proposal that U.S. firms receiving orders for Canadian Bomarc equipment sign a contract agreeing to buy goods of equal value from Canadian firms.

ALPA Seeks Age Limit Hearing

In a move to force a hearing on proposals to impose age limits on pilots, Air Line Pilots Assn. last week asked the Federal Aviation Agency to "reject in their entirety" the proposed rules. ALPA, now convinced that evidence to support the ruling is lacking, feels that a hearing would force FAA to drop its age proposals. In a step toward obtaining such proceedings, ALPA has submitted to FAA its supplementary recommendations for rejection of the rule. In its statement supporting the recommendation for rejection, ALPA reasoned this way: "It is mandatory that if, even in the face of obvious lack of evidence, there is any intention of proceeding any further with the FAA proposals, an evidentiary proceeding be established in which any facts in connection with these proposals may be fully developed."

Khrushchev Lauds Soviet Science

Soviet Premier Nikita Khrushchev mirrored Russian enthusiasm for the nation's scientific achievements in this triumphant speech before a recent session of the Supreme Soviet as reported in the Soviet press:

". . . These days, our wonderful scientists have made another wonderful gift to our motherland. They paid good court to the moon and she regarded them with favor, allowing them to photograph the side which she (applause) had so far kept secret from the sight of man. (Applause continues.) We are truly proud of the Soviet scientists who persuaded the moon to lift her veil, a remnant of the past. (Applause.) Under the influence of Soviet science and culture, the moon discarded her veil, began to go in step with our time, and revealed her face to Soviet scientists and to the Soviet people. They made it possible for the whole world to acquaint itself with the sacred secrets of this celestial beauty, but of course only with the moon's permission, because we are not Peeping Toms. (Applause.)

"Permit me from this lofty rostrum to warmly congratulate our hero-scientists for this wonderful scientific feat, in the name of the Soviet government, the Supreme Soviet, and the CPSU Central Committee. (Long applause.) Permit me to wish them new successes, discoveries and similar brilliant achievements to the glory of our great country, victorious communism, in the name of the triumph of peace on earth. (Long applause.)"

Electronic Research Increase

Electronic Command and Control Systems, such as Strategic Air Command Control System (465-L) and Intelligence Data Handling System (438-L), now represent a substantial part of the total Air Force research and development program involving expenditures of billions of dollars, Brig. Gen. D. E. Newton, Jr., told a recent meeting of the Armed Forces Communications and Electronics Assn. The Air Research and Development Command chief of staff said the number of such systems is growing. Air Force will send out requests for industry proposals on new hardened Norad Combat Operations Center (225-L) this month. Next systems program to be launched is expected to be the Pentagon Command Post (473-L).

Quesada on Tour

Federal Aviation Agency Administrator E. R. Quesada took off last week on an around-the-world evaluation and study trip that will take him to Russia, Afghanistan and eight countries in the Far East. Purpose of the trip, which is being sponsored by the International Cooperation Administration, is to check FAA facilities, airways and air traffic control operations and evaluate FAA technical assistance programs which are conducted with ICA funds. The itinerary includes a two-day stay in Moscow where Quesada will discuss "aviation problems" with U.S. embassy officials. He will return to Washington Dec. 5 after a stopover in London on the flight from Moscow to the U.S.

—Washington staff

Space Technology

USAF Drafts Dyna-Soar Contract Terms

Boeing, Martin win awards for boost glide vehicle; subcontractors to be selected on competitive basis.

By Evert Clark

Washington—Air Force begins negotiations this week with Boeing Airplane Co. and the Martin Co. for development of the Dyna-Soar manned boost glider that will explore the potential of this type vehicle as a global-range weapon system.

Letter contract agreements, expected to be reached in a week or 10 days, will be followed by selection of subsystem and component contractors on a competitive basis. This will be done by Boeing and Martin, with USAF approval.

Boeing was chosen last week to develop the glider and Martin the rocket booster. The decision came after more than four months of review of the work done in the previous year by the two six-company teams which Boeing and Martin headed. No member of the former teams is guaranteed a position as a subcontractor, USAF says.

Dyna-Soar will represent the nation's first attempt to fly in near space and return by means of a lifting type of re-entry vehicle. Since this type vehicle is considered the logical step beyond the high drag capsule type of re-entry vehicle represented by National Aeronautics and Space Administration's current Project Mercury, NASA will play a large role in the Dyna-Soar development. Because cost of such a vehicle, particularly if it develops into a full fledged weapon system, is so high, no parallel civilian program will be undertaken.

New Management Techniques

New management techniques—with technical direction of the project remaining within the Air Force—have been dictated by the great scope of the project and its technical complexity.

A number of analyses under the Dyna-Soar program and through Air Research and Development Command's Systems Requirement Study Program have proposed the use of a boost glide vehicle as an orbital bomber, reconnaissance aircraft or patrol plane. The current development program, however, is more in the nature of a research aircraft project than a weapon system. An Air Force spokesman told AVIATION WEEK:

"It is an attempt to sort out and investigate the most promising of these potentials and determine what usefulness, what costs, what political implications, etc., there may be.

"The essence of this type of vehicle is that it will permit us to return from orbital speed under controlled conditions and to land. If it is successful, it could have many military applications."

Initial tests of the first glider will be by air drop from a Boeing B-52 near Edwards AFB, Calif., using the same technique employed in the X-series of research aircraft. Next will come launchings of the glider without a pilot by means of a Martin Titan missile booster from the Air Force Missile Test Center's Cape Canaveral, Fla., site. These tests will be followed by booster launching of manned flights.

The super Titan booster once included in the Martin team's proposal has not been specified for the current development program. USAF will say only that some booster will be selected from the national booster program for later launchings. If an intermediate size is needed, the Atlas-based Centaur—which was a part of the original Boeing team proposal—might be chosen. If the jump is made from the Titan to a very large booster, the 1.5-million lb. thrust Saturn would be a logical choice.

Boeing's position in the program essentially is that of principal contractor, with responsibility for manufacture of the vehicle, integration of vehicle subsystems, integration of vehicle and booster, and assembly and test. Martin will manufacture the booster.

Systems management will rest with the existing Dyna-Soar Weapon System Project Office at ARDC's Wright Air Development Division. More of the responsibilities and more resources for management will remain with this office than with the principal contractor.

"This is the first time that the Air Force will develop a system that uses missile, space and aeronautical technologies," one project official said. "The Air Staff and ARDC were required to examine this very closely and ensure that it had the very best internal and external management possible.

"It is obvious that there are relationships with NASA—for example, we will need a global tracking range—with the missile program, with the Atlantic Missile Range and so on, so it was felt that Air Force should provide systems management rather than someone else."

Systems Management

Dyna-Soar program management, therefore, will more closely resemble the kind of systems management and planning done by USAF in the ballistic missile program than it will the approach used on some aeronautical weapon systems—for example, the Convair B-58, where both administrative integration and planning and the actual mechanical integration of contractor-furnished equipment was handled largely by the prime contractor.

Wright Air Development Division was chosen as the ARDC location for the systems management office because the major technical areas involved in the vehicle are structures, materials, stability and control, human factors, communications and guidance and other specialties of that center.

USAF's Ballistic Missile Division, which was a contender for management of the program, will be the principal agency for adaptation of boosters for Dyna-Soar. Some industry observers have interpreted the selection of WADD as an attempt to put weapon systems management back into the more normal channels used before the advent of BMD—through its management of missile boosters—acquired a principal role in a number of space projects such as Discoverer, Samos, Midas and advanced reconnaissance satellites. USAF says this is not the case—that WADD was the logical choice for the technical reasons cited above.

Contractors for subsystems and components will be selected by Boeing's Aerospace Division and by Martin, possibly through its Space Flight Division, on a competitive basis. They will use Air Force rules, and selections are subject to USAF approval. No

USAF B-70 Proposed To Launch Dyna-Soar

Washington—USAF-North American B-70 bomber has been proposed as a recoverable launcher for satellites and orbital versions of Dyna-Soar type gliders. The Mach 3 bomber could be used to put a 10,000 lb. glider into a 300-mi. orbit by lifting the glider plus a 40,000 lb. liquid rocket booster to an altitude of 70,000 ft. and releasing them while it traveled at a speed of about 2,000 mph. Maximum payload of the B-70 for short ranges is far in excess of the 50,000 lb. required for such a mission.

source selection boards will be convened, as they were in the systems area.

As USAF explains this procedure, it is a source selection conducted by the two main contractors, with USAF looking over their shoulders. Ordinarily, if source selection boards are not used, the prime contractor picks a subsystem contractor, and USAF either approves or disapproves. If it disapproves, the prime makes another choice and tries again. This new approach is aimed at ensuring selection of an acceptable subsystem contractor the first time. Air Force rules of competition are imposed, and the contractor essentially is acting as an agent for USAF.

Some members of the two former Dyna-Soar teams interpret this as more a question of "rejustification" of the subsystem contractors involved in the original teams than a selection of new contractors, but Air Force insists that no subsystem or component maker is assured of a place in the new program by virtue of the fact that he was on the vehicle part of Boeing's team or the booster part of Martin's team.

Widespread industry dissatisfaction resulted from the use of a similar approach in the recent Minuteman missile and air-launched ballistic missile competitions (AW July 6, p. 26). In the case of the Minuteman, Boeing eventually ended up with substantially the same team members it had had in its original proposal but only after considerable time was spent reviewing, rejustifying and reselling USAF on the other members.

In the case of the air-launched ballistic missile, Douglas Aircraft Corp. as prime finally ended up with Nortronics Division of Northrop Corp. for guidance contractor after several times proposing General Electric Co., its original guidance partner.

Under the Dyna-Soar competition for first phase development, held between June, 1958, and last spring, Boeing's teammates, excluding booster manufacturer, were Aerojet-General Corp. for launching base design; Chance Vought Aircraft, Inc., for pilot capsule and escape mechanisms; General Electric for tracking and telemetering system; Thompson Ramo Wooldridge for reconnaissance system; North American Aviation's Autonetics Division for automatic flight and landing system; Goodyear Aircraft Corp. for radio guidance system; RCA for high resolution radar development.

Martin's teammates were Bell Aircraft Corp. for the vehicle; Bendix Aviation Corp. for communications, telemetry, hydraulics, electrical power conversion, cabling and electric connectors; Goodyear for crew escape capsule system and radar system; Minneapolis-Honeywell for guidance and navigation and American Machine and Foundry Co. for ground handling and launching equipment.

USAF procurement policies with regard to small business, broad industrial base, depressed areas, etc., will be applied as fully as possible in selecting the new group of contractors.

Timetable and funding for Dyna-Soar have not been announced, but there is every indication that technological and budgetary reasons are making it a longtime, relatively low-support development program. Dyna-Soar has cost $53 million through Fiscal 1960.

No flights are expected short of approximately three years. USAF expects to have both X-15 and Mercury flight experience to draw on before the first manned Dyna-Soar flights are made, and the first orbital Mercury flight is believed to be a full two years away.

NASA's role in Dyna-Soar will be "full and authoritative," according to Air Force. The distinction between the USAF-NASA relationship in the X-15 program and Dyna-Soar is one of funding, technical arbitration and ultimate responsibility. NASA, USAF and Navy are partners in the X-15 project, with NASA in the chief technical role; in Dyna-Soar, technical positions of NASA and Air Force are reversed, and USAF will do the funding.

NASA has one man in the Weapon System Project Office now and will have more personnel there as the program grows. Dyna-Soar will have the formidable task of exploring heating, stability and control, etc., in several critical velocity ranges as it investigates the flight corridor up to 18,000 mph.

USAF's slower approach may provide more technical knowledge at a lower cost and produce a better system in the long run. An opposing school of thought argues that a useful boost glide vehicle could be built in a much shorter time with existing technology and that this approach should be taken for both military and political reasons in view of Soviet progress in space flight.

Dyna-Soar Structural Approaches

Washington—Completely different structural approaches were used by the two industry teams competing for the Dyna-Soar boost glider contract.

Boeing team's glider would have used a "hot" understructure to carry the main loads. This understructure would stabilize out at the same temperature as the outer skin, or at a maximum of about 3,000F. Virtually all joints and junctures in this structure were designed to expand without warping out of shape and building up thermal stresses, which could cause failure.

Theoretically, "hot" construction of this type is lighter than a cooled and insulated structure. Chief drawback is that the materials needed are not fully developed. Some estimates are that it will be at least five years before high temperature materials reach the point where they can be used to satisfy basic Air Force requirements for a boost glide weapon system.

Fundamental requirements are that a glider maintain high speed over targets at the relatively low altitude of less than 50 mi. This would increase effectiveness of weapon delivery systems, reduce chances of successful counteraction and allow return to a distant landing area.

Missions of this type demand that the structure withstand maximum temperatures for an hour or more as compared with a maximum heating period of 20 min. or less for re-entry from orbit.

Last year, USAF initiated a large contractual effort to study the feasibility of using available heat resistance materials for hypersonic leading edges on boost gliders. It wanted reusable structures that would withstand temperature ranges from 2,500F to 3,000F. Ablation and cooling techniques were excluded.

"Hot" structure materials now undergoing a rigorous laboratory testing program include silicon carbides, graphites, molybdenum alloys, several heat resistant coatings, and the refractory metals, all of which are brittle. Design techniques are now in development.

Martin-Bell team approach was a cooled, insulated glider airframe on which the understructure temperature never got above 200F. Construction of such a vehicle could have been begun two years ago, according to some government and industry engineers. The outer skin was lightly loaded with sliding and expanding joints similar to those of Boeing's glider, but a heavy layer of insulation separated this skin from the understructure. Hollow sections built into the understructure would have been pumped full of water before flight, and a wick-like material would have absorbed the water to prevent sloshing. As understructure temperature rose, the water would become steam and absorb about 1,050 Btu./lb.

Vents would be provided so that the steam pressure would not build too high. Even though this design eliminated internal plumbing and pumps, it is generally considered to be heavier than the "hot" structure would be after materials are developed.

Defense Employment Practices To Be Probed by Congress Unit

Washington—Appointment of Dr. Charles L. Critchfield to run Defense Department's Advanced Research Projects Agency while his salary is paid by industry (AW Nov. 9, p. 25) will result in a close congressional examination of Defense Department's employment policies.

Rep. Chet Holifield (D.-Calif.), chairman of the House Military Operations Subcommittee, has asked his staff to look into various aspects of the appointment to determine the course of action to be taken by the subcommittee after Congress reconvenes in January. Dr. Critchfield's new job is not subject to congressional confirmation.

Holifield made it clear that the legality of the appointment was not being questioned, but that terms and conditions of the appointment would be thoroughly aired because of the possible implications involved. The appointment was made on the basis of a provision in the Second Supplemental Appropriations Act of 1951 which was enacted as an emergency measure to help the government obtain consultants without compensation.

This law gives the Defense Department authority to appoint up to 10 persons as consultants who would be exempt from the conflict of interest statutes and would not be required to sever connections with private industry.

Defense Department said that Dr. Critchfield would retain his $36,000-a-year position as director of scientific research for the Convair Division of General Dynamics Corp. and move into the $19,000-a-year ARPA post this week, serving without government pay. He is scheduled to replace Roy W. Johnson, who has served as ARPA director since its inception early last year.

There was speculation in Washington, however, that Critchfield may make a last minute decision to refuse the post because of criticism of the appointment which leaves him on the payroll of Convair, a firm heavily involved in defense work supervised by ARPA, and the disadvantages in which it would place his company. Under the appointment, Critchfield would be barred from any contact with defense contracts involving Convair.

Holifield said he questioned the wisdom of borrowing a man from a company working on government contracts to head an agency allocating contracts amounting to millions of dollars.

Subcommittee staff said the inquiry probably will cover more than Dr. Critchfield's appointment and will go into the entire Defense employment picture, including questions of how procedures to administer the law are adopted, how the laws are enforced and who has been employed under these procedures.

The subcommittee suggested earlier this year that more attention be focused on Defense Department employment practices during hearings on organization and management of missile programs (AW Mar. 23, p. 34). At that time, the subcommittee questioned the ARPA contract with the Institute for Defense Analysis, a nonprofit organization, to provide professional personnel under somewhat different arrangements than those under which the Critchfield appointment was made.

Under the IDA arrangement, professional personnel are given leaves of absence from their companies and receive their compensation from IDA while staffing ARPA positions. The subcommittee report said the situation created a difficult and delicate situation. "As the Defense Department agency controlling the major funds for advanced research," the report said, "it invites intense curiosity from industrial firms and an understandable desire to have a direct pipeline to the inner sanctum. The issue is not so much the obtaining of immediate contracts but of getting valuable information for future business opportunities."

In addition to IDA employes, those serving in the Defense Department and drawing compensation from outside the government are:

- **John M. Sprague,** acting assistant secretary of defense (comptroller), vice president of the Carter Oil Co.
- **John R. Townsend,** special assistant for fuels and materials, Research and Development Office, who is employed by Bell Telephone Laboratories.
- **Hector Skifter,** assistant director for air defense, Research and Development Office, who is president of Airborne Instrument Laboratory.
- **Edwin Paxon,** assistant director for tactical weapons, Research and Development Office, who is employed by Rand Corp.

Rocket Records Electron Density

Washington—Army fired a Strongarm research rocket to an altitude of 1,050 mi. last week to measure electron density in the upper atmosphere. Launch was one of a series in the U. S. program for international geophysical cooperation.

Fired in cooperation with the National Aeronautics and Space Administration, Strongarm reached the highest altitude ever recorded at NASA's Wallops Station before falling into the Atlantic Ocean about 800 mi. from its launcher.

Rocket was launched to obtain data on the decrease in ionization at altitudes of up to 1,000 mi. Army is interested in this data because of its relation to the environment in which intercontinental ballistic missiles and anti-ICBMs will operate.

Rocket and payload were developed and assembled by the University of Michigan Research Institute under contract to the Army Ballistic Research Laboratories. Rocket beacon was a transmitter developed by the Michigan group which broadcast on 37 and 148 mc. Measurement at ground stations of the difference in phase of the two signals permits calculation of electron densities in the atmosphere through which the signals traveled.

Strongarm rocket was 56.48 ft. long and weighed 7,125 lb. at launch. First three stages were an Honest John and two Nike Ajax boosters. Fourth stage was a Yardbird, which is a slower burning version of the Recruit. Fifth stage was a one fifth scale Sergeant. Strongarm is similar to the Jason rocket but has higher performance in the last two stages.

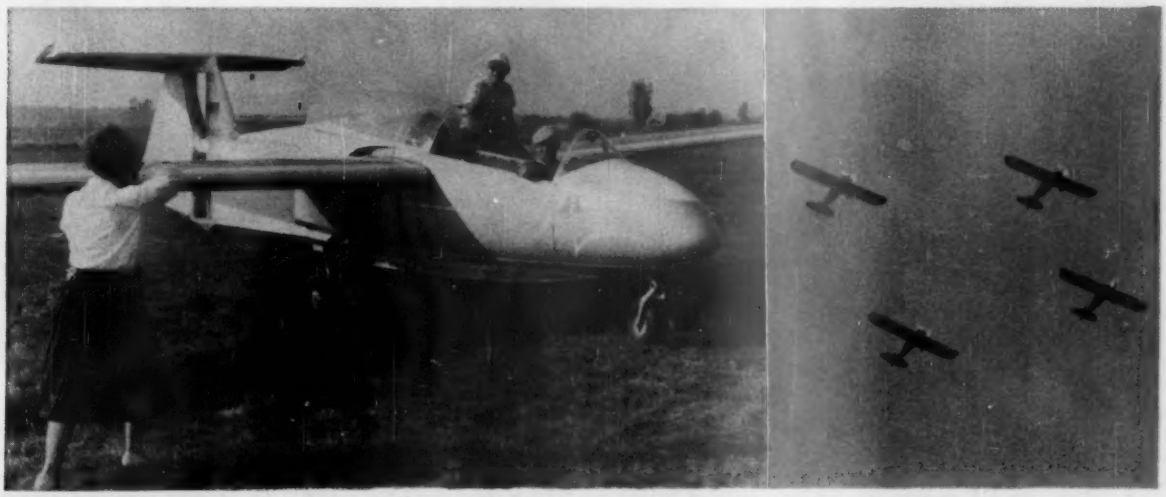
Rocket burned out at about 17,250 ft. per second at an altitude of about 180,000 ft. and coasted to its peak altitude. It was aerodynamically stabilized, and the fiber glass nose cone and attached fifth stage were coated with Teflon to protect them from aerodynamic heating. Transmitter antenna was mounted flush under the fiber glass in the nose cone, and a thermistor indicated that temperature was held to 160C at the interface between the fiber glass and the ablating Teflon. Douglas Aircraft Co. fabricated the nose cone and coated it and the fifth stage rocket case with Teflon.

Strongarm payload was tracked from Wallops Station from Aberdeen Proving Ground and from the Millstone Radar Station at the Massachusetts Institute of Technology. Data will be available to all nations participating in the continuation of the International Geophysical Year effort. A second Strongarm shot is scheduled to be made at night later this month. Data will be compared with day launch results to explore the sun's effect on the ionosphere.

Gliders and lightplanes cover most of the main parking area at Baden-Baden, in preparation for international meet.

German Aero Club Organizes International Meet

First international competition of sport and touring aircraft was organized by the German Aero Club. Participants had to be members of any national aero club belonging to the Federation Aeronautique Internationale. The event was rounded off with a three-day rally at Baden-Baden, Germany, where gold and silver medals were awarded the winners. Purpose was to establish whether there still is enough interest among private pilots to induce them to enter for a contest requiring days of arduous flying on the lines of prewar Europe flights and rallies, or whether they prefer to take the shortest route in order to join the international meeting. Strongest contingent in all three groups of 70 aircraft which completed the course at Baden-Baden were the American lightplanes such as the Cessna 170A, 170B, 175, 182 and 310C; the Beechcraft G50, Beech Bonanza K35 and G35; and Piper PA-24, PA-22, Piper Tri Pacer and Piper PA-18 types. Rudolf Knittel, flying a two-seat RW-3 aircraft which is powered by a 65 hp. Porsche engine, was awarded the silver medal. With this machine he landed 30 times in 6 different countries. Three points were awarded for each stop made at an airfield in the country where the aircraft is registered; 25 points for each foreign country where a landing was made during the flight and six points for each separate landing made in a foreign country. The Burda Squadron flew the entire course of the competition. The squadron is named after Sen. (Dr.) Franz Burda, one of the keenest supporters of private flying in Germany, and head of Burda Druck-und Verlags-G.m.b.H., (publishers), of Offenburg.



Two-seat RW-3 was flown by pilot Rudolph Knittel (in cockpit) to win silver medal; at right is Burda Squadron formation.

Soviets Improve Computer Technology

By Philip J. Klass

Washington—Soviet computer technology is advancing rapidly but appears to lag a year or more behind U. S. computer technology in the opinion of several members of an eight-man team of U. S. experts who spent 10 days visiting Soviet computer facilities and factories.

However, several team members, who reported their observations here at a seminar sponsored by the Office of Naval Research, speculated that the Russians may not have disclosed all of their latest computer developments and techniques.

The Soviets appear to follow a firm policy of "tit for tat," showing the U. S. team facilities which correspond to those seen by a team of Soviet experts who visited the U. S. earlier. Because of military security, the Russians were not able to visit certain U. S. computer manufacturing facilities.

Following are some of the observations on Soviet computer technology reported during the ONR seminar:

• **High-speed magnetic tape** transports for computer input-output use appear to lag considerably behind U. S. developments. Several Russian computers use punched movie-type film with eight data storage tracks, which provides 75 words per second. This is comparable in speed to punched tape used in the U. S. but considerably slower than U. S. magnetic tape input-output equipment.

• **No etched circuit boards** were seen in any of the Soviet computers. The Russians, however, do make widespread use of plug-in circuit modules in their computer construction.

• **Machine translation of foreign** languages is being pushed hard in the Soviet Union. Program appears to be more comprehensive, better organized than the U. S. effort. Present efforts are directed toward translation of English, German, Japanese and Chinese into Russian.

• **Deposited thin magnetic films,** among the newest techniques in the U. S., are being actively investigated by the Russians. Best results have been obtained using an 80/20 permalloy with film thicknesses of about 2,000 angstroms. The Soviets say they hope to obtain switching times of 20-to-50 milli-microseconds but are having difficulty in achieving uniform film characteristics.

• **Computer manufacturing techniques** employed at the Soviet computer factory in Penza appear to be every bit as modern as those in use in this country.

• **Magnetic drums used as memory** devices in Soviet computers achieve storage density of about 100 bits per inch, comparable to that achieved in the U. S. Russians use a one mil spacing between drum and read-write head. Heads are preheated before rotor is started to maintain a clearance between the drum and head when the drum expands due to internal heating.

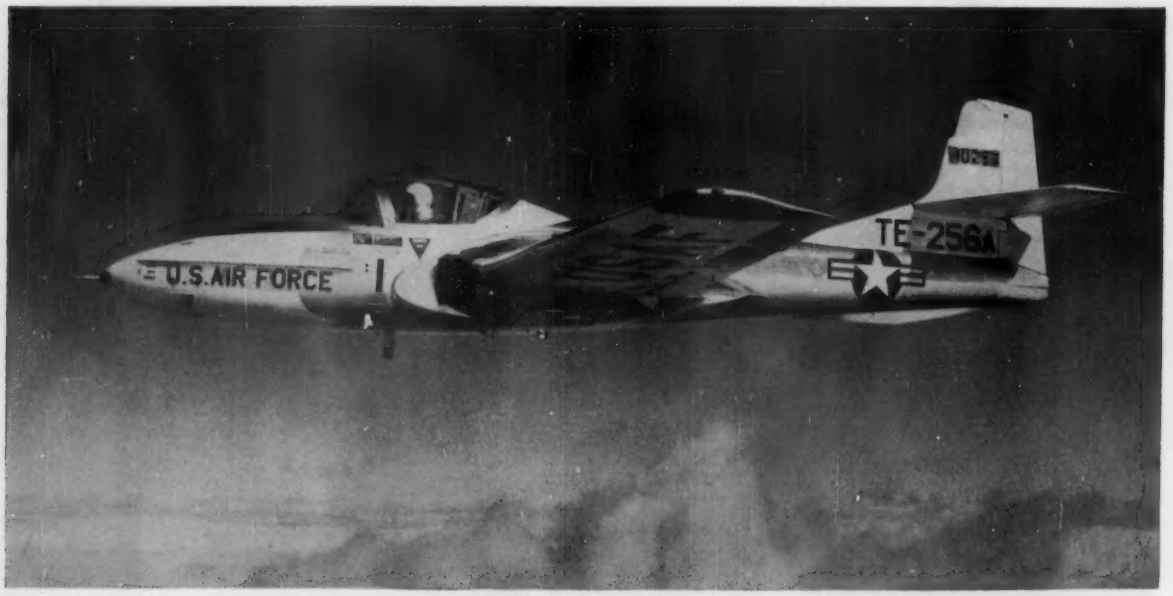
• **Deposited carbon resistors** are used universally, even when precision resistors are not required. One possible explanation is that fabrication of deposited carbon resistors is a more easily mastered art than that of producing cheaper composition resistors.

• **Small desk-size analog computers,** which appeared to be the equal of anything available in the U. S., were in widespread use in laboratories visited by the U. S. team.

• **Computer scientists keep abreast** of the latest computer developments in the U. S. and elsewhere through USSR's rapid translation and distribution service. "Their access to our literature is both complete and amazingly fast," Dr. Morris Rubinoff, University of Pennsylvania, told the seminar.

• **Automatic programing of computers,** under study for several years in the USSR, does not appear to have aroused too much enthusiasm among Soviet computer scientists.

• **Transistors, diffused-base** type, capable of operating at frequencies up to 120 mc. were shown to U. S. visitors. Russians, however, appear to be having trouble fabricating transistors with uniform characteristics. In a group of tran-



Cessna Delivers First T-37B to Air Force

USAF's first Cessna T-37B intermediate trainer is powered by two Continental J69-T-25 turbojet engines rated at 1,025 lb. thrust each. These engines supersede the J69-T-9s, rated at 920 lb. thrust each, which power the T-37A. Other changes are installation of Collins AN/ARC-34 UHF communications; Collins VOR-101 VHF navigation, including 51X-2 receiver, and 344B-1 VOR/LOC instrumentation system. An M5 ejection seat has been installed to increase ejection speed from the aircraft. Air Training Command primary flying schools will receive retrofit kits developed by Cessna and Continental for converting J69-T-9s to J69-T-25s.

sistors which have an average Beta (gain) of 50, the figure for individual units in the group frequently range from as low as 10 to as high as 250, a considerably greater spread than found in U.S. transistors. The Russians say they are producing transistors for communications equipment use that can operate at frequencies as high as 400 mc.

• **Very high-speed printer** capable of printing 50 lines per second is now under development. The machine, while considerably faster than any U.S. printer, is limited to numbers and does not print letters. Machine stores up to 10 lines at a time, prints them all simultaneously.

American visitors were shown a number of Soviet computers now in production or in use, several new computers in the prototype stage plus several in development.

• **Bessem I:** One of the first large Russian digital computers, this machine originally had an acoustic memory, later changed to cathode ray tube storage and, still more recently, to ferrite core memory. This computer, which can perform an average of 8,000 operations per second, is roughly comparable in speed to the IBM 704.

• **Bessem II:** Improved version of the earlier model, with approximately the same speed, is in the prototype stage.

• **Ural I:** Small digital computer which operates at the relatively slow speed of about 100 operations per second is in widespread use in the Soviet Union and has been exported in small numbers to India, China and Poland. More than 150 of these machines have been manufactured.

• **Ural II:** Advanced version of the earlier model, with much higher speed (8,000 operations per second), and with more advanced organization. Magnetic drum is used instead of the coincident current magnetic core memory employed in Ural I.

• **Strela:** This computer is believed to have been produced in several models. Its speed is about 2,000 operations per second.

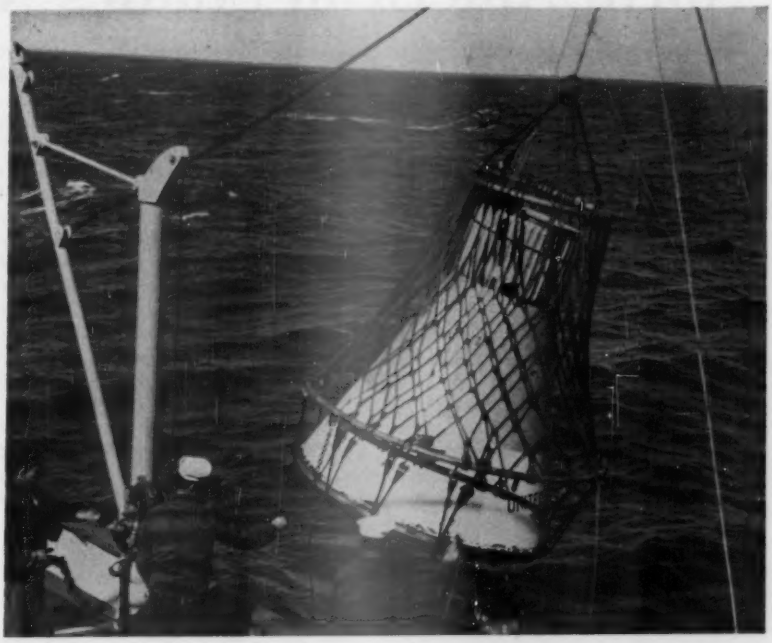
• **M-20:** A new very high-speed computer now under development, which reportedly will have capability of 20,000 operations per second. This makes the computer comparable to the IBM Norc computer produced several years ago for the Naval Ordnance Laboratory.

• **Kiev:** An asychronous machine with a speed of about 6-8,000 operations per second.

Other Soviet computer developments which were discussed but not seen by the U.S. team included the Lem I recently described in Russian literature, which uses magnetic elements predominantly in its logic; the Rasden, a medium-speed transistorized computer, and the Aragaut.

Mercury Recovery Test

Navy salvage ship recovers Project Mercury capsule from the Atlantic Ocean five miles offshore from National Aeronautics and Space Administration's Wallops, Va., Station. Boilerplate capsule was launched in a test of the pilot escape system under maximum aerodynamic loads (AW Nov. 9, p. 29). Capsules carrying animals will be fired later.



Russians disclosed that they are using the Bessem I computer to forecast weather in the northern hemisphere. The Strela is being used for linear programing studies. One of these involves the calculation of the best distribution and inventory of sand in the vicinity of Moscow for the city's widespread construction. Sand is distributed from eight supply points to several hundred points of use.

The four U.S. scientists who reported their observations at the ONR seminar included Prof. Harry H. Goode, University of Michigan; Dr. Morris Rubinoff, University of Pennsylvania; Dr. Samuel N. Alexander, National Bureau of Standards, and Dr. Lipman Bers, New York University. Their itinerary included the Institute of Precision Mechanics and Computing Techniques in Moscow, the Moscow Computing Center, Moscow University, Institute of Telemation and Mechanics, the Leningrad University Computing Center and a Soviet computer manufacturing facility at Penza, southeast of Moscow.

SKID MARKS at top of photo show the path the North American X-15 research plane made during emergency landing.

North American Studies X-15 Damage

Edwards AFB, Calif.—Failure of fastenings at a point just aft of the auxiliary power unit bay, where forward and center sections of the fuselage are attached, were the apparent cause of the North American X-15 sustaining what appeared to be a broken back after a recent emergency landing (AW Nov. 9, p. 34). The plane will be repaired.

Photos and chase pilot reports by Maj. Robert White, USAF pilot who will fly the X-15 and who flew alongside test pilot Scott Crossfield and the X-15 during the landing, indicate that Crossfield made an excellent landing, so that the landing apparently was not the cause of the failure.

However, whether the failure may have started in the air as a result of the explosion in one of the two XLR-11 rocket engines which power this research plane, with the landing impact serving to aggravate the failure, had not yet been determined.

While there was no estimate of the cost of the damage sustained, it was estimated that the airplane's structure could be repaired within five weeks. Some of the manufacturing technicians who originally worked in the X-15 shop have been brought back from projects to which they had been transferred when the last of the three X-15 vehicles were finished some weeks ago.

Biggest concern in the incident has been over the cause of the engine explosion and fire. Although Crossfield reportedly barely felt the explosion, chase pilot White said he had seen it. The blast occurred seconds after the rocket ship was dropped from the Boeing B-52 mother ship.

Engines from the plane, the No. 2 aircraft, have been sent back to the powerplant branch at Air Force Flight Test Center here, while the airframe was trucked back to North American's Los Angeles plant for examination and repairs.

Plane has been disassembled and the liquid oxygen tank, just aft the attach point where the fastenings failed, is undergoing inspection for ruptures and other damage. Also being checked is

FIRE GUARDS stand ready as North American technicians inspect damaged fuselage shortly after the landing.

the plane's Inconel skin in this area.

There were reports that possibly not all the liquid oxygen was jettisoned when Crossfield dumped propellants after the red fire warning light showed after the explosion. Opinion differs as to whether weight of the remaining liquid oxygen may have influenced the structural bending.

During the descent, Crossfield determined that the control system functioned normally and had not been damaged by the explosion, even though the lines run approximately through the center of the fuselage. Throughout the approach, the aircraft continued to respond normally to control and Crossfield elected to land rather than abandon the research vehicle.

North American spokesmen could not immediately explain why the fuselage failed, although the landing was normal, according to Crossfield. It was pointed out, however, that this was the first time the X-15 had been landed after dumping fuel rather than burning it. Considerably more stress might have been placed on the structure because of the added weight of remaining propellants. Jettisoning the fuel load, according to North American, does not as completely expend the propellants as does consuming them in the engines. After complete disassembly and investigation and when preventive measures are taken, the research program will continue. Harrison Storms, project engineer, said, "we will continue our program with the No. 1 X-15 as soon as we determine the nature of the incident."

Repair of the X-15, second of three aircraft, was termed by North American as "not impossible."

Thiokol Wins Contract For Spherical Rocket

Washington – Thiokol Chemical Corp. has a $50,000 contract to develop and produce solid propellant spherical rocket motors for National Aeronautics and Space Administration re-entry research program.

Thiokol will develop and produce spherical motors based on the 5 in. motor developed by NASA for use in its six-stage re-entry research rocket (AW Oct. 26, p. 54). The spherical motor is the last stage and is fired downward into the atmosphere at re-entry speeds. Thiokol motor will be considerably larger than the NASA motor on which it is based.

NASA also has awarded a $140,000 contract to Minneapolis-Honeywell Regulator Co. for fabrication of a guidance and control system for the Scout vehicle and a $50,000 contract to Avion Division of ACF Industries, Inc., for Scout radar tracking beacons. Other contracts awarded in September:

- **University of Michigan,** $90,000; basic research on the plumbing erosion that occurs under high temperatures in certain rocket engines.
- **Geophysical Corp. of America,** $110,000; instrumentation to measure electron density in the ionosphere.
- **Pratt & Whitney Division,** United Aircraft Corp., $100,000; investigate heat transfer potentialities of a number of materials in a near-vacuum under extremely high temperatures that would be encountered in a nuclear-electric generating system.
- **Society of Photographic** Scientists and Engineers, $50,000; operational expenses for volunteer photo and radio tracking of earth satellites.
- **Republic Aviation Corp.,** $73,000; study of lunar and interplanetary space probe trajectories.
- **Bendix Radio Division,** Bendix Aviation Corp., $2 million; operation of Minitrack stations for 1960.
- **Instituto Geofisico de Hyancayo,** $110,000; operation of tracking and receiving station at Lima, Peru.

Russian Records

Moscow—Eight payload-altitude or payload-speed records were set last month by Russian aircraft, including a lift of 55 tons to a height of 13,000 meters (42,653 ft.), the Soviets report.

The aircraft which carried the 55-ton load was a four-engine turbojet designated 201M. The Soviets said this beat the previous record set by a KC-135 which carried 78,089.5 lb. to an altitude of 6,562 ft. on Sept. 24, 1958, at Chicopee Falls, Mass.

Another Soviet four-engine turbojet designated 103M set seven records Oct. 30 when it flew a 1,000 km. course (621.4 mi.) with a 27-ton payload at an average speed of 639 mph., the Soviets said.

This flight, at 7,000 meters (22,967 ft.) altitude, the Soviets say, broke speed records with payloads of 1, 2, 5, 10 and 15 tons and set two "utterly new" records for speed with payloads of 20 and 25 tons.

Data on the two flights is being forwarded to Federation Aeronautique Internationale for registration.

Discoverer Failure Caused by Inverter

Vandenberg AFB, Calif.—Recent attempt to effect separation of Discoverer VII capsule from its orbiting second stage resulted from faulty electrical equipment although all other phases of the launching were successful. Douglas Thor-boosted Discoverer VII satellite (second stage Bell Hustler engine plus re-entry body) was first heard by Alaskan stations (Kodiak and Annette) 1 hr. 28 min. after launching, as the satellite orbited with an apogee of 528 stat. mi. and perigee of 103 stat. mi. Orbit time was 94.6 min.

Communications continued to be satisfactory, all stations receiving telemetry. However, after the third orbit fluctuations of the beacon signal indicated that the satellite was in a slow tumble, perhaps three times per minute. According to telemetry signals, the satellite's inverter was not functioning. This unit supplies power to the infrared sensor sending signals to the pneumatic control system which stabilizes the satellite. The inverter also provides power which operates the separation sequence (re-entry vehicle from second stage).

Air Force's recovery crews nevertheless were alerted through the 17th pass on the chance that the inverter might cut in again to effect separation, but no telemetry confirmation of cut-in was received. The entire second stage now is in orbit and is expected to remain there until Nov. 21.

This was the fifth precision polar orbit attained with Discoverer out of seven firings. It was the first time a malfunction in the satellite system occurred, as distinguished from the capsule system located in the re-entry body.

New Martin Division Prepares Titan Bases

Denver—Recently-organized Martin Co. Activation Division will have permanent headquarters in Denver for its job of preparing field facilities for Air Force's Titan ICBM weapon system.

Activation Division is managing and integrating the efforts of Titan system subcontractors who are providing equipment and facilities for Titan training and operational launch bases. The new division, formed last June, is responsible for having the facilities completed when the Titan is ready to be activated in the field. Titan is being developed here by the Martin Denver Division.

Current work involves managing construction projects at the Vandenberg AFB training base and the initial operational site here at Lowry AFB. Work is scheduled to start this fall on launch sites at Mountain Home AFB, Idaho; Ellsworth AFB, S. D.; Beale AFB, Calif., and Larson AFB, Wash.

Martin is developing and producing the Titan at its Denver Division, and establishment of permanent headquarters for the Activation Division here keeps the company's Titan program efforts concentrated near the production and initial operational sites.

Structural Beefup Distinguishes F-104G

Burbank, Calif.—Lockheed F-104Gs ordered by West Germany will be structurally beefedup versions of the F-104Cs now being used by USAF's Tactical Air Command. In addition to the structural strengthening, which will permit the aircraft to fulfill the low-level part of its multi-mission capability, the F-104G will have a fire control system with a wider range of capabilities than the system in the F-104C.

The Canadian F-104s on order probably will follow the G-model features in a number of areas (AW Nov. 9, p. 29). The F-104G lightweight export airplane recently offered by Lockheed is structurally the same as the F-104C, but the equipments differ. However, the equipments of the G are optional on the -9, and a customer can have an F-104-9 with the F-104G capabilities if he can afford them.

For the high speed, low altitude mission, 36 new forgings have been provided for fuselage main frames, wing fittings and beams, fuselage longerons and joints, fuselage tail frames, empennage beams and ribs, plus some fuselage skins. In this condition, the F-104G is to meet strength requirements with full external loads for the fighter-bomber task.

Several changes have been made in the tail group, a modification has been made on horizontal stabilizer servomechanism for increased hinge movement, the vertical tail has increased the over-all area by 25% (this first appeared on the F-104B), the rudder is powered and provides both yaw damping and directional control with a single surface as does horizontal stabilizer and ailerons, eliminating a separate yaw damper service.

Additional performance margin with takeoff flap setting has been determined for the F-104G and, consequently, the available load factor is increased for the ground attack mission, and a decrease in turn radius at low level also is achieved.

Drag chute for the F-104G is 18-ft. diameter, 2 ft. larger than the 16-ft. chute used by the USAF F-104C. Other additions are an air scoop leading edge and inlet ramp anti-icing by electrical elements.

An increase of 120 gal. in internal fuel can be accomplished on F-104G by installing special aluminum tanks in the spaces for the rapid-fire cannon, ammunition and shell cases. Fuel tanks and gun installation are interchangeable.

For armament, two Sidewinder heat-seeking missiles, in addition to two on the wingtips double the missile-carrying capability. The two belly missiles also can be carried in combination with pylon and wingtip fuel tanks for increased range interceptor mission.

A force stick steering autopilot is incorporated which includes altitude, heading, and Mach holds plus a constant g (standard rate) turn. Electronic unit gets its inputs from the central air data system.

Fire control system will be North American Aviation Autonetics Division's NASARR, a radar and fire control computer. System operates in air-to-ground mode for bombing and navigation, air-to-air for target interception and also is capable of providing data link information readout.

NASARR is connected to a director type gunsight which gives pilot an optical indication of line-of-sight with proper lead angle for firing the M61 gun. In the caged or fixed condition the sight is used as an aiming reference when firing Sidewinder missiles or for visual dive bombing attacks. When used with infrared aiming, the sight can be used at night. A new infrared sight is being developed for daylight visual use which is compatible and integrated with the director sight in the use of common optics and will have improved detection range.

Bomb computer used in the F-104G ties in with the inertial navigator, air data system and NASARR and mechanizes relationship between bomb trajectory and aircraft in space to ensure bomb release at proper point in space. Four modes are included, dive-toss, LABS, over-the-shoulder, and level flight.

Air data computer gets analogs from pitot and static pressures, air temperature and angle of attack from remote transducers and transforms data into a form usable for readouts for the pilot and computers in the aircraft.

A small, lightweight automatic navigating device called PHI (position and homing indicator), developed by Computing Devices of Canada, is installed which works on dead reckoning principles, computing where it is by remembering where it started and keeping track of all course and speed changes. Pilot has a choice of five destinations and chooses by pushbutton. Indicator shows him the proper course to fly to get to the destination he selects, and also distance to go in nautical miles. No maps or charts are needed. Tacan also is programed for installation in the F-104F.

In addition, the F-104G incorporates a lightweight, fully automatic inertial navigation system which requires no external support and does not emit any electromagnetic radiation. It measures actual ground distance and track and is not dependent on forecast or computer winds.

B-58 Conversions

Washington—Convair will convert 13 of the 30 B-58 bombers built for flight test to operational configuration. They will be assigned to USAF squadron service.

Five of the 30 test aircraft have been lost in ground and flight accidents, and of the remaining dozen, four will be converted to pilot trainers with dual controls replacing the bomb-navigation equipment in the second cockpit; two are being modified to carry the F-108 fire control and search radar and will be used in the development of this system; five will continue on flight test status, and one stripped airframe will eventually be destroyed in static and dynamic structural tests.

Japan Picks F-104

Tokyo—Final decisions on a $200 million program for the production of approximately 200 Lockheed F-104C jet fighters in Japan appear imminent.

Selection of the Lockheed aircraft as the backbone of Japan's air defense was made by a Japanese Defense Agency mission, headed by Gen. Minoru Genda, over five U. S. competitors (AW Nov. 9, p. 23). It has been approved by Japan's Defense Council and announced in Tokyo. The U. S. Defense Department's Office of International Security Affairs is awaiting the submission of a formal proposal by Japan.

Competing aircraft evaluated by the Genda mission during a U. S. tour in August were the North American F-100, Convair F-102 and F-106, Grumman F-11F-1F and the Northrop N-156F.

The program is opposed by the Socialist party, which controls a third of the votes in the Diet. Appropriations to implement the F-104C program are subject to approval by the Diet.

Details of partial financing by the U. S. under the mutual security program remains to be worked out. U. S. is understood to be willing to put in between $75 and $100 million.

The Lockheed F-104 also has been selected for air defense by Canada and West Germany and will be produced by the two countries. Canada's first F-104 is due off the assembly line in April, 1961; West Germany's in October, 1961. Belgium and the Netherlands have shown an interest in either direct purchase of F-104s, or a program for production.

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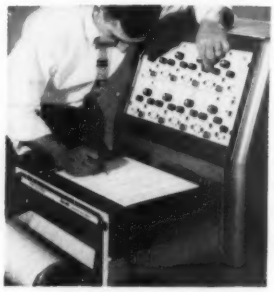

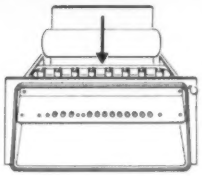

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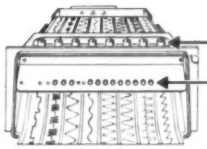

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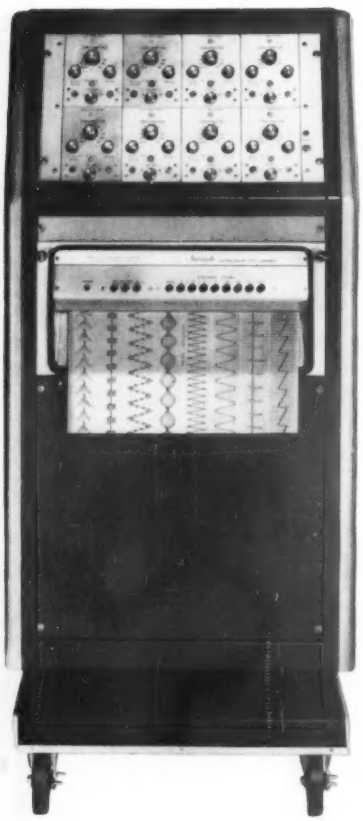

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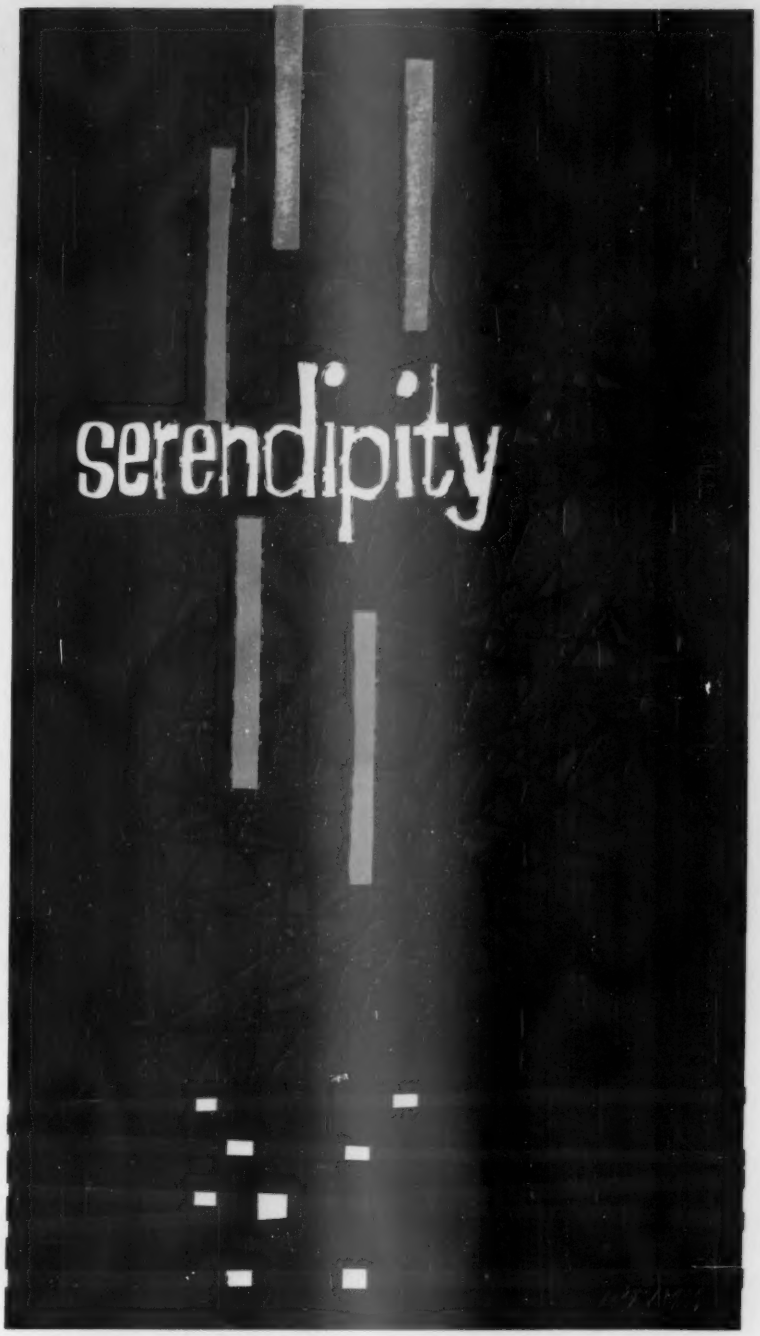

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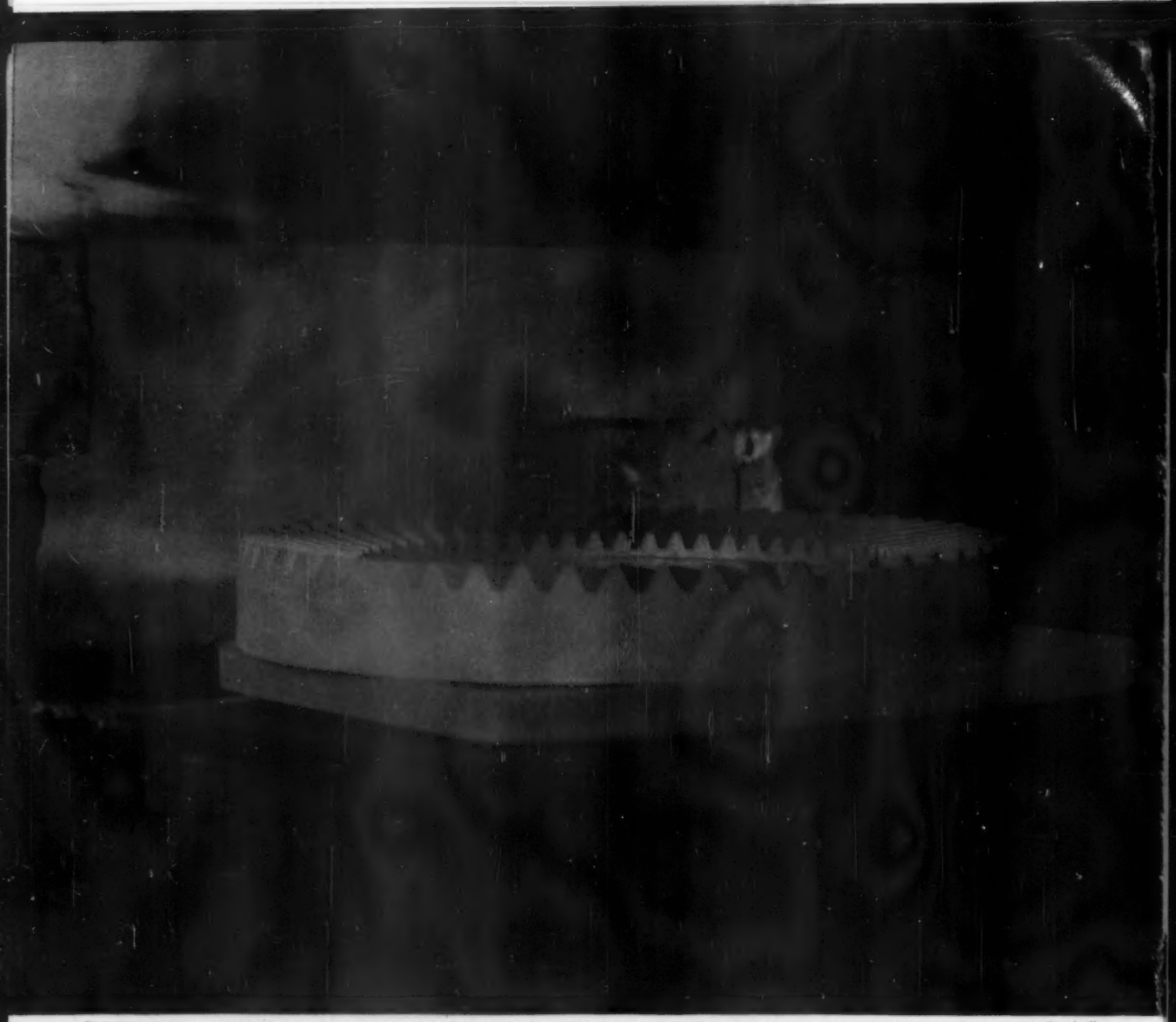

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NASA Issues New Regulations On Space Act Patent Waivers

By Craig Lewis

Washington—National Aeronautics and Space Administration has modified and clarified regulations governing patent waivers under the Space Act, but more basic changes in NASA's controversial patent authority will have to wait for congressional action next year.

New regulations clarify the inventions eligible for waivers and the conditions and procedures under which NASA will waive title to inventions. Generally, the regulations rule out waivers on inventions that have significant utility in space applications.

First waiver to be issued under the patent provisions of the Space Act went to Pratt & Whitney Aircraft Division of United Aircraft Corp. Waiver covered 31 inventions involved in advanced engine development work Pratt & Whitney is doing under Air Force contract and which NASA is funding.

Generally, the Space Act says NASA obtains title to any invention or discovery made in the course of work under a NASA contract when the inventor is assigned to work supported by NASA or when the invention is related to work under a NASA project.

Industry has strongly objected to these patent right limitations, and NASA is expected to propose a change in the law that would provide discretionary authority similar to that of the National Science Foundation (AW Aug. 24, p. 26). Such authority would make clear the need to protect the public interest but would allow NASA to decide how to do it. This would permit NASA to make its patent policy more compatible with Defense Department policy and give industry a more consistent pattern under which to work.

Waiver provisions were added to the Space Act by Congress to meet some of the objections to the patent section. Interim regulations governing waivers were issued last March and, since then, hearings have been held and comments have been received from industry and the American Patent Bar. Now changes have been made based on these comments plus NASA's experience with the regulations since they were first issued.

New regulations apply to all inventions conceived or first actually reduced to a practical state under the NASA contract conditions which give the U.S. title to them. NASA policy states that waivers will be considered in the public interest when private ownership of patent rights will stimulate early development of an invention to a practical state or where "substantial equities" justify retaining the private rights.

NASA has barred inventions relating significantly to space technology from waiver eligibility. Included in this category are inventions primarily related to development and operation of manned or unmanned vehicles capable of sustained flight without the support of the atmosphere and inventions which are of basic importance in research on problems related to these space vehicles. NASA also will refuse waivers on inventions relating to atomic energy or special nuclear material unless the Atomic Energy Commission approves such a waiver.

For inventions not included under this ban, the inventor will have a prima facie case for a waiver or an exclusive license when the invention has a predominantly commercial value or when a company has made a much larger investment in support of the research producing the invention than NASA.

Another prima facie case for a waiver is an invention that was conceived and submitted for a patent before NASA issued a contract, but which was first reduced to a practical state with NASA funds. Also included is an invention that was conceived or first reduced to practice under a contract with a university or non-profit research organization which concentrates on scientific research, providing the contract does not call for delivery of models or equipment or the development of practical processes.

NASA will waive its rights to an invention in countries outside the U.S. when the agency decides not to apply for a patent on the invention in the countries involved.

With all these waivers, NASA retains the right to an irrevocable, nontransferable, royalty-free license for the practice of an invention throughout the world, either by the U.S. or its agent or by any foreign government in line with a treaty or agreement with the U.S. This provision retains for NASA a royalty-free right to use an invention for government purposes, even if patent rights have been waived.

To ensure that contractors will put inventions to use rather than shelving them once a waiver is issued, NASA has established conditions under which certain waivers can be voided. These conditions apply to waivers issued for inventions of predominantly commercial value and for those in which contractor investment is considerably bigger than NASA's.

In these categories, waivers can be voided if the invention is not developed to the point of practical application or licensed either royalty-free or at a reasonable rate. These conditions must be met within five years of the grant of a patent or within eight years of the granting of a waiver, whichever is earlier. Waiver can be continued beyond these limits if circumstances justify an extension.

News Digest

General Motors Corp. will build the Minuteman ICBM erector carriage and transporter tractor under subcontract from Boeing.

Raytheon Co. has developed a new form of graphite, with controlled crystal orientation, that gives it novel thermal, electrical and other properties and may enable ballistic missile nose cones and rocket engines to operate at higher temperatures.

United Aircraft Corp.'s nine month sales and earnings showed a decline in sales from $914,245,345 from the period a year ago to $796,494,872; earnings dropped from $30,504,323 to $23,151,-648. In another report, Grumman Aircraft Engineering Corp. said nine month earnings were $5,595,644, nearly double the $2,814,107 for a similar period last year. Sales rose from $161,-188,545 to $199,529,175.

Republic of Indonesia is purchasing five C-130B transport aircraft from the Georgia Division of Lockheed Aircraft Corp. with an option to buy five more. A substantial down payment already has been made by the Indonesian government, and progress payments will be made under contract conditions. Cost of the C-130B runs between $2.3 and $2.5 million depending upon internal equipment and spares provided. Lockheed reports that the purchase is being made entirely with Indonesian funds, with no foreign aid money involved.

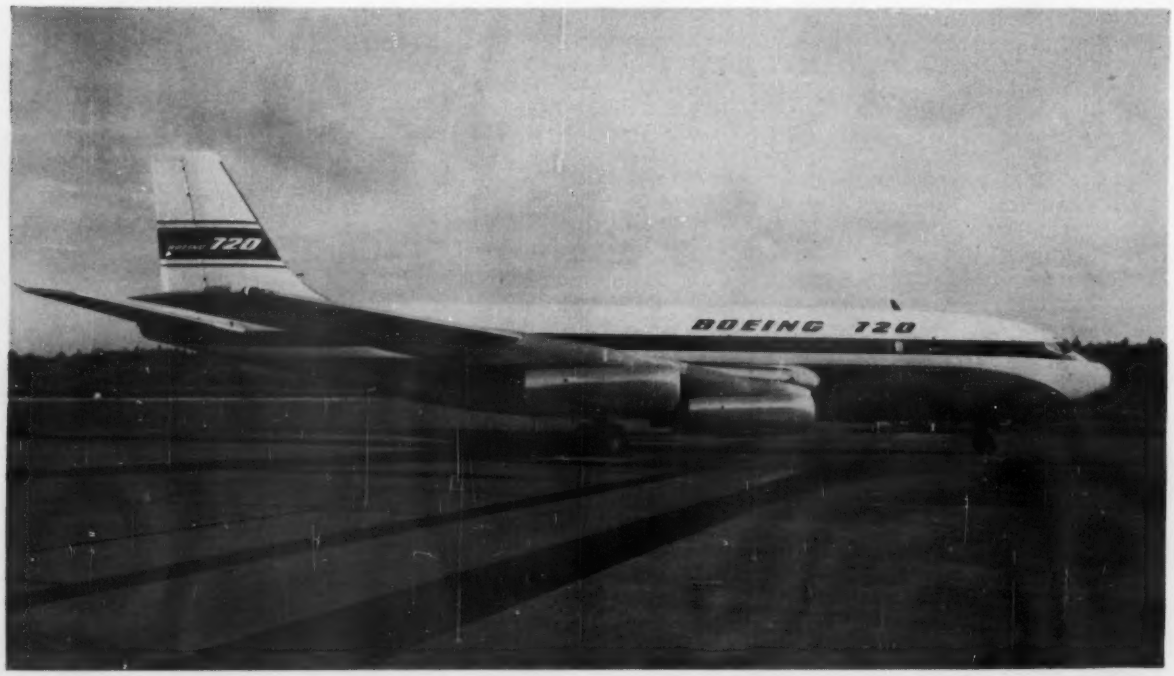
Hiller Aircraft Corp.'s X-18 VTOL is making high-speed runway tests at Edwards AFB, Calif. (AW June 29, p. 15). Flight testing is scheduled to begin by December. Air Force completed a final engineering safety inspection of the 16½-ton tilt-wing aircraft last month.

Republic Aviation Corp. has increased thrust of the F-105's Pratt & Whitney J75 turbojet by 2,000 lb. with the addition of water injection. Total thrust with afterburner now exceeds 26,000 lb.

Electro-hydraulic actuator system to power Minuteman ICBM control mechanisms will be designed and developed by Chance Vought Aircraft's Electronics Division under contract to Autonetics Division of North American.

Boeing Rolls Out First 720 Medium-Range Jet Transport

First Boeing 720 medium-range turbojet transport is rolled out at Boeing Transport Division factory at Renton, Wash. Aircraft, the first of 18 to be built for United Air Lines, will be delivered to the carrier in April after Federal Aviation Agency tests are completed. Production 720s incorporate several wing changes from the 707-120, including a new leading edge which increases sweep and delays critical Mach point, and three leading edge flaps which improve landing and takeoff performance (AW Nov. 9, p. 42).



Airlines Urge Higher Rates for Mail Plan

Lines that would participate in expanded program file objections, reservations to CAB proposal.

By Ford Eastman

Washington—Higher rates than those proposed by the Civil Aeronautics Board for the transportation of first-class mail by air are being urged by a majority of the airlines which would participate in the Post Office Department's expanded program.

Responding to the CAB's show cause order setting forth the proposed rates (AW Oct. 26, p. 38), airline reaction filed at the Board last week varied from outright objection to unqualified acceptance. Several carriers indicated they would accept the proposed rates with reservations, while still others suggested that they be made temporary pending a hearing on their reasonableness.

Meanwhile the Board has scheduled a prehearing conference for 10 a. m. tomorrow requesting each party to present statements of position as to the acceptability of the rates specified in the show cause order on the following basis:

• **Temporary,** pending conclusion of the proceedings and subject to retroactive adjustment upward or downward from the effective date of the temporary rates.

• **Interim final rate basis** not subject to retrospective change for a period not exceeding six months from the date of the prehearing conference or the final Board decision in the docket, whichever is earlier.

Rate Formula

In the show cause order, the Board proposed rates based upon the multi-element rate formula used in establishing air mail rates but at 50% discount. This would give domestic trunklines an average return of 19 cents per ton-mile and local service carriers a return of 30 cents per ton mile, approximately the same as that both now receive under a limited experimental program.

Mail compensation is computed by adding line-haul charges and the mail ton miles multiplied by the line-haul rate of 15.085 cents a ton mile to terminal charges, which range from 1.66 cents per pound to 16.605 cents per pound, depending upon the size of the originating station.

Major objections to the proposed rates filed by individual airlines included complaints that:

• **Terminal charges should** not be established at 50% of present charges for air mail and air parcel post because the cost of handling non-priority mail might be higher than that for air mail due to additional handling problems involved in moving mail on a space-available basis.

• **Volume of first class** mail handled by the airlines will make it more difficult for the carriers to accommodate on a space available basis within the period and the time required by the Post Office Department. In view of the limited time during which first class mail may be held for carriage or else be lost to other carriers, airlines will tend to give priority to this mail. Therefore, some carriers contend that it is not space-available traffic in the true sense and does not justify the 50% discount from air mail.

• **CAB has not taken** into consideration the amount of air mail traffic that will be diverted because of the expedited movement of first class mail. As the program expands and first class mail service improves, the carriers contend, the public will rely less on air mail and more on first class mail which eventually could result in a big revenue loss to the airlines.

• **Proposed rates,** insofar as they would apply to the carriage of mail between points in the 48 contiguous states and points in Alaska, are too low and may raise serious questions of just compensation due to higher costs of carriers operating between the areas. Rates for non-priority mail moving to Alaska, airlines contend, should be related to the present air mail rates to the state and should not be based upon a modification of the domestic rates which are inapplicable to air mail moving to Alaska.

No objections to the proposed rates were filed by local service carriers, all-cargo airlines or the Post Office Department.

Following is the position taken by each carrier answering the Board's show cause order:

• **American Airlines**—Accepted the rates proposed by the CAB provided regulations are issued prohibiting any air carrier from transporting such mail on any basis other than non-priority space-available traffic and prohibiting any air carrier from accepting or storing such mail in excess of that which can be accommodated by the carrier within a reasonable period of time. Higher rates would be required, American said, if the mail were to be given priority over any other class of airline traffic except that moving as deferred air freight, if the airlines were to increase capacity in order to accommodate this mail rather than only using it to top off loads and if the airlines were to accept or store such mail in excess of quantities that can be promptly accommodated.

• **Allegheny Airlines**—Does not object to the proposed rates and is in agreement with the over-all policy decision expressed in the Board's order. It expressed concern, however, over certain aspects of the proposal, including the volume of mail to be moved and the number of pouches involved; possible need for a minimum rate per pouch handled, and a possible directional imbalance in rates resulting from station classifications. The airline, which asked the Board to maintain a continuing surveillance of the program, also questioned whether the service will, in fact, be on a non-priority basis.

• **Braniff Airways**—Will accept the proposed rates as temporary for the carriage of non-priority mail subject to retroactive adjustments upon the outcome of a Board investigation of the

High Density Il-14

Moscow—Russia is modifying a portion of its large fleet of obsolescent twin-engine piston-powered transports to provide greater passenger capacity and profit potential.

Both the 18-passenger version of the Il-14 and the 24-passenger Il-12 are being converted to a 32-seat configuration. Aeroflot predicts that each 32-passenger Il-12 will be able to gross 400,000 rubles ($100,000) more annually than a 24-passenger version, while the operating costs will remain essentially unchanged.

The high-density Il-14M32, now in service on Aeroflot's domestic routes, is given additional seat space by rearranging the baggage, radio and service compartments forward of the cabin. Under certain load conditions, a ninth row of removable seats can be put in the Il-14M32's baggage compartment, providing space for four more passengers.

plan. Braniff said, however, it had serious misgivings as to the adequacy of the present rates and suggested adoption of a non-priority mail rate utilizing the terminal charges applicable to air mail but providing only a portion of the line-haul charge which, it said, appears to be more reasonable than the 50% allocation of both terminal and line-haul charges from the multi-element mail rate. Braniff also said there undoubtedly would be a substantial diversion of existing air mail which would tend to make existing air mail rates inadequate; that the final rates should meet a fully allocated available ton mile cost based upon all carriers and all equipment rather than the costs of long-haul carriers with Douglas DC-6 equipment and that, while some type of priority status may prove to be desirable as an end result of the Board's investigation, it should not be permitted on the basis of the rates set in the Board's current order.

• **Continental Air Lines**—Objects to the terminal charges which the Board proposes to set at 50% of the present charge for air mail. Continental says the charges should be the same as those for air mail. The airline also objects to the proposed rates being made final at this time and requests that the Board set a temporary rate instead. The airline accepted the establishment of a multi-element rate formula and did not object to the proposed line-haul charge of 15.085 cents a mail ton mile.

• **Capital Airlines**—Is willing to accept the proposed rates subject to the understanding that the mail is to be transported only on a voluntary space available basis. It also reserved the right to challenge the adequacy of the rates if it finds them to be unfair or unreasonable in the future.

• **Delta Air Lines**—While willing to accept proposed rates for carriage of non-priority mail, Delta has serious reservations as to the long-term propriety of both the general rate and the terminal charge portion of the formula. It has asked the Board to give full consideration to the average line-haul costs of all airline operators involved and to investigate the possibility that the average carrier's terminal costs for handling non-priority mail may actually exceed its terminal costs for handling priority air mail and air parcel post because of such factors as Post Office dispatching procedures, dimensional weight problems and carrier responsibilities connected with en route removals, warehousing and return of mail to post offices.

• **Eastern Air Lines**—Objects to the proposed rates as being too low but proposed they be made temporary effective immediately and subject to retroactive adjustment. Eastern said the proposed rates are not adequate in relation to costs and suggested a rate that would produce a return of not less than 27.75 cents a ton mile.

• **National Airlines**—Objects to the proposed rates on grounds that they are unreasonably low and do not provide adequate compensation for the transportation of mail by air. National requested the Board to assign the proceeding for hearing. The airline suggested that the line-haul rate be set at not less than 22 cents per ton mile instead of the proposed 15.085 cents, and that the terminal rate per pound be the same as that for air mail.

• **Northwest Airlines**—Objects to the proposed terminal rate on grounds that direct handling cost will be equal regardless of the type of mail and, therefore, should be the same as for air mail. Northwest also requested that the show cause order be amended to exclude Alaskan points from the proposed rates and that the rates set for carriage of mail to and from Alaska should bear a relationship to the present air mail rates to the state rather than a modification of the domestic rates.

• **Pacific Northern Airlines**—Objects to the proposed rates insofar as they apply to the carriage of first class mail between the 48 contiguous states and Alaska. Cost of air carriers operating to, from and within Alaska always have been substantially in excess of costs of domestic carriers, Pacific Northern said, and added that the Board has recognized this fact in fixing mail rates for such carriers in the past. The airline pointed out that the service mail rate for Seattle-Alaska service is now 47 cents per ton mile as compared with an average rate of 38.47 cents per ton mile paid to domestic carriers in 1958. It suggested that the rate for non-priority mail bear the same relation to the service rate for air mail as the postage rate for first class mail bears to the postage rate for air mail. This would produce a rate of 27 cents per ton mile, which, the airline said, would be reasonable.

• **Pan American World Airways**—Does not object to the proposed rates but says that, in the event hearings are held on any aspect of the rates or their application, the airline reserves the right to be heard. The airline said the proposal would be applicable to Pan American's operations to a relatively limited extent since it does not engage in domestic operations.

• **Slick Airways**—Accepts the proposed rates and requests CAB to establish the rates as final.

• **Trans World Airlines**—Objects to the rates on grounds they do not cover the cost of first class mail service and provide a fair profit, are below the rates for standard freight service and are erroneously based upon a cost standard without reference to the value of first class mail service. TWA said the rate should be substantially increased to take into account the fact that the mail must either be moved or lost in a relatively short time. It believes the minimum fair and reasonable rate should be 24 cents a ton mile, and that there is considerable justification for a higher rate.

• **United Air Lines**—Does not object to the fixing and establishing of the proposed rates. At the same time, United said it does not want its acquiescence in the matter to be interpreted as full concurrence either in the manner proposed for the computation of such mail compensation or in the rate levels that will result. The airline pointed out that terminal costs may be somewhat higher than for priority mail and that there is no persuasive justification for discounting the rate for movement of the mail by as much as 50%. United added that any particular formula, percentage or rate level determined as a result of the proceeding cannot form a precedent for the long term. The program most likely will evolve into all-up mail carriage which will need priority and the rate should return full costs plus a reasonable and proper return.

• **Western Air Lines**—Accepts the proposed rates, but reserves the right to change its position if the mail is to be moved on any basis other than space available.

New CAB Member

Washington—Alan S. Boyd last week was named a member of the Civil Aeronautics Board by President Eisenhower to fill the remainder of the term of Louis J. Hector who resigned last September (AW Sept. 21, p. 36). Boyd, a Miami attorney and chairman of the Florida Railroad and Public Utilities Commission, will serve until Dec. 31, 1962. He will be a recess appointee until January when his nomination goes to the Senate for confirmation.

Allegheny Orders 540s

Washington—Allegheny Airlines signed an agreement with Napier Engines, Inc., last week for five Convair 540 turboprop transports and took options on 10 more.

Aircraft involved in the tentative agreement will be Convair 440s converted to Napier Eland turboprop power. No decision has been made on which of three bidding companies will do the conversion work. Present agreement between the airline and Napier covers purchase terms and maintenance guarantees. A definitive contract will be signed within the next few weeks.

Allegheny has been evaluating a leased Convair 540 since July 1 on its Pittsburgh-Philadelphia and Pittsburgh-Atlantic City routes in scheduled service.

Hawaiian Bids for New Pacific Routes

By L. L. Doty

Honolulu—Hawaiian Airlines, buffeted into a request for subsidy by the new competition of Aloha Airlines in the limited inter-island travel market, is striving to regain its competitive foothold by expanding its routes as a regional Pacific carrier.

During the recent Trans-Pacific Route Case hearings here (AW Nov. 9, p. 39), Arthur D. Lewis, Hawaiian Airlines president, disclosed his new concept of the airline as "a regional carrier in the Pacific, serving routes radiating out of Hawaii to the major gateways on the mainland U. S., in the Orient and in Australasia." The plan is based on the principle that the vast areas of the Pacific will be reduced to regional size by the high speed of the jet transports and envisions Honolulu as the hub of this operation where the company's headquarters and maintenance and overhaul base will be located.

The strong support the HAL proposals for the new routes received from local interests within the 50th state catapulted the opening hearings here from the usual humdrum routine of such proceedings into a lively battle as other participating airlines, recognizing Hawaiian's gains in the case, sought to discount the carrier's position.

Most observers here feel, however, that the carefully prepared HAL testimony gave the airline an initial momentum that may be difficult to slow down as the case develops. The airline seeks routes from San Francisco and Los Angeles to Hilo and Honolulu, a triangular route between Los Angeles, Honolulu and Tahiti and beyond to Auckland and Sydney. It also wants a route from Honolulu to Tokyo, Okinawa, Hong Kong and Manila.

In making its bid for the route, the carrier has stressed that it is neither a local service nor territory carrier but holds a trunkline certificate under the grandfather clause of the Civil Aeronautics Act of 1938. Summarily, the towering stack of evidence, testimony and exhibits offered Civil Aeronautics Board hearing Examiner William J. Madden brought out these additional facts:

• **HAL will lease one DC-8** from Douglas Aircraft Co. and purchase up to five of the turbojets if it is granted all the routes it has requested (AW Oct. 5, p. 37). It has signed an agreement with Douglas for the sale, arranged a financing program to cover the entire purchase and has laid out detailed plans for the operation and maintenance of the planes.

• **Company plans to meet** the challenge of Aloha's F-27s with a fleet of seven specially modified 52-seat Convair 440s which are being equipped with an improved exhaust system, triple pane windows and substantially heavier soundproofing to reduce the noise problem. With this high seating capacity, as compared with the F-27's 40-seat capacity, coupled with an extra 1,000-lb. freight capability and relatively low operating costs, HAL believes the Convair 440 will be a more efficient airplane on the inter-island route structure than the F-27. Slight difference in speed is not considered by HAL to be a significant factor on the short-haul routes of the carrier's system. After considerable study and evaluation, the airline has decided against converting its Convairs to turbine power unless Aloha's turboprops continue to divert traffic. If the conversion is made, HAL prefers the Allison turboprop over the Napier Eland. Earlier this year, the carrier took delivery on three Convair 340s with the 440 engine modifications installed, and the original fleet of four Convair 340s is currently being converted to full 440 configuration by HAL. Along with these seven Convairs, HAL operates five 32-passenger View-Window DC-3s and two DC-3 freighters. Full fleet of DC-3s will be retired as soon as feasible.

• **HAL proposes to exercise** its regional concept by developing schedules that would assure Hawaii of adequate service to the peripheral gateways and develop traffic potential within the Pacific region, "including the long-neglected but latent potential of the South Pacific." The carrier will promote routing of traffic over the Central Pacific route between the U. S. and the Far East with emphasis on Hawaiian layovers.

• **Management of the company** has been completely reorganized as a major move toward strengthening its inter-island operations and preparing for the normal processes of route expansion.

• **Passenger appeal of the F-27**, introduced on June 15 by Aloha Airlines, forced a sharp drop during the summer in Hawaiian's participation in the inter-island market from 70% to 57%. This resulted in a loss of $31,500 on inter-island operations for the first nine months of 1959 as compared with a profit of $18,100 over the same period of last year. During his testimony, Lewis emphasized that a route expansion is essential to HAL's financial health since the "very small market" available in Hawaii will not support two airlines whose routes parallel one another.

Under the terms of the agreement with Douglas, HAL will lease the first Douglas DC-8 turbojet transport which came off the manufacturers production line for a period of 84 months beginning Oct. 1, 1961, at a monthly rental fee determined by multiplying the purchase price of the plane by .01500515. Basic purchase price is now $5,100,885 and estimated cost of the engine, included in the basic purchase price, is $967,800. Both prices may be increased or decreased according to price changes at the time the lease becomes effective.

Hawaiian will handle all insurance with All-Risk Hull Insurance and will undertake all maintenance and overhaul of the airplane at its Honolulu base.

In the event HAL's route structure is increased as a result of the Trans-Pacific Route Case, the carrier may purchase a minimum of two additional DC-8s from Douglas. If all routes it is requesting are granted, Hawaiian holds an option for three more DC-8s.

Upon execution of the agreement, HAL will pay Douglas $50,000 which will give the carrier the right to lease the first DC-8. When the agreement to purchase the two DC-8s is signed, the $50,000 will apply to the purchase price of the planes. If the option to buy is not exercised, Douglas will retain the $50,000.

The airline has not decided whether to buy the Pratt & Whitney JT3D-1 turbofan or the JT3D-3 turbofan but, in any event, it will purchase up to 32 of either model and specify that a fuel boost pump drive be provided in the right end of the accessory gear box of each engine.

Engines will be paid for with quarterly payments with a 7% interest rate on the unpaid balance plus a handling charge of 1% per annum of the purchase price. Current price of the JT3D-1 engine is $194,690, of the JT3D-3 engine, $203,190. The manufacturer is offering a seven-year payment period but prefers five years.

Initially, the company will sell equity securities in an amount sufficient to provide the cash required to make progress payments on the two DC-8s and to cover all other expenditures necessary to begin and sustain service. According to a statement by Louis D. Miltimore, a partner of Kidder, Peabody & Co., Hawaiian should be able to raise the necessary funds to operate a trans-pacific route ". . . assuming satisfactory conditions in financial markets and assuming that nothing has occurred to modify materially the company's projections of revenues and earnings as filed in connection with this hearing." As to the type of securities HAL will

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undertake to sell, Miltimore said:

"It would be our expectation that a substantial part of the equity would be raised through the sale of common stock. It is possible that a portion of the equity could be more advantageously raised through the sale of other equity type securities, such as subordinated debentures, possibly carrying conversion privileges which would ultimately lead to further broadening of the company's common stock base."

Immediately after certification, a credit agreement will be concluded by HAL with its banks. The credit agreement, which will provide for no drawdowns until the date the DC-8s are due for delivery, will represent the 67% installment due on delivery of the aircraft plus 50% of the cost of spare parts that will have been acquired with equity funds.

Funds to be provided under the credit agreement will not be made available unless the senior debt to equity ratio is no greater than 1.25:1. In addition, recent operating experience must show evidence that the debt can be serviced by the cash flow from operations. If these conditions are not met at the time of delivery of the aircraft, Douglas has agreed to lease the purchased aircraft to Hawaiian for one year to allow the airline time to meet the loan requirements.

Additional payments on the aircraft will be made from excess cash flow from operations as the new routes are implemented.

The over-all program, therefore, hinges on HAL's ability to win new routes in the Trans-Pacific Route Case. Without the routes, the airline will not purchase jet equipment since its present earning powers will not permit it.

During the first 20 years of HAL's 30 years of operation, earnings averaged an 8½% return on invested capital without benefit of subsidy. During the past 10 years—since 1949 when Aloha was certificated to operate the inter-island routes—earnings have averaged only 1% after receiving $2.2 million in subsidy.

Company's reorganization came in 1954 after it had lost $592,000 leading to a default in a then-existing bank loan. Following the reorganization, which involved a drastic management shake-up, the carrier worked back into a profitable condition with net earnings of $183,000 in 1957.

Last year, Hawaiian reported a loss of $115,000 in the inter-island operation, but net profits from charter operations of its single DC-6C aircraft offset the loss and gave the company a profit for the year of $10,500. However, because of the impact of Aloha's F-27s on the inter-island market, HAL is forecasting a loss for 1959 and is now in the process of filing a petition for temporary mail pay after going off subsidy in the spring of 1957.

Here are the principal problems facing HAL in its inter-island operations:

• **Traffic is short-haul,** averaging 135 mi. for each passenger at an average ticket sale of $12.67.

• **Operations are peaked** by the hour of the day, day of the week and by season. Business day is short with no demand for service before 7:30 a.m. or after 6 p.m. As a consequence, aircraft utilization is low.

• **Traffic is imbalanced.** High load factors are experienced on flights outbound from Honolulu early in the morning, but low load factors prevail on inbound flights at the same time. A reverse of this imbalance is experienced on afternoon flights.

• **Inter-island market** is growing slowly. During the past five years, traffic growth has held to an average rate of 3% per year as compared with an annual increase of 11.2% for trunklines and 16% for local service carriers.

According to Lewis, "there is no indication that our trend will significantly change in the future, even with a substantial surge in tourist traffic among the neighbor islands." He adds:

"In fact, the growing concentration of population and economic activity in Oahu suggests that the growth rate of inter-island traffic may drop still lower unless the trend is reversed by the development of destination areas on the neighbor islands providing opportunity for local investment and job opportunities."

On the transpacific route, Lewis forecast that in 1962 a total of 174 passengers per week will move in each direction between Hawaii and Japan. He also predicted that an additional 1,875 one-way passengers per week will travel between Los Angeles-San Francisco and Japan in 1962.

Lewis made a strong plea for a route to the South Pacific during the hearings. He said:

"Hawaiian Airlines thinks that the decade of the 1960s will witness the opening of the South Pacific to the world and U. S. tourists. Thus far, the very heart of this area has been isolated by the absence of direct air service . . . Tahiti and French Polynesia represent one of the great undeveloped traffic potentials of the world, and it would be our intention to make a major effort to develop Tahiti, along with other Polynesian islands, to exploit the latent community of interest between this area and Hawaii and between this area and the mainland U. S., in a manner similar to the development of the community of interest between Hawaii and the United States."

Under present plans, HAL, if it wins the routes it seeks, will operate 80 flights a week during the first full year of operations.

Lake Central Route Bid Supported

Washington—Lake Central Airlines was recommended last week to replace Trans World Airlines on a Cincinnati-Detroit route by a CAB examiner.

Suspension of TWA on the route and the grant of a five-year operating authority between the cities for Lake Central was proposed by Examiner Paul N. Pfeiffer on the condition that the local service carrier show evidence that it will be able to serve the route with modern pressurized equipment.

The examiner also said award of the route to Lake Central with nonstop rights between the two cities would improve the local service system in the Indiana-Ohio area and reduce the carrier's subsidy needs by an estimated $250,000 annually. Pfeiffer pointed out that the carrier already serves the intermediate cities of Columbus and Dayton.

TWA, in an earlier proceeding, had indicated it would be willing to sell its rights on this route segment for $310,000 and in the present case told the Board that the north-south traffic flow between the two cities does not integrate with the airline's primary east-west routings.

In indicating a willingness to relinquish the route, TWA requested that any final CAB order in the case stipulate that the route was suspended, rather than deleted, from its route system. Concurring in this request, the examiner said that should the five-year award to Lake Central prove unworkable, TWA could then be reinstated without legal complications.

Pfeiffer rejected bids by North Central and Piedmont Airlines on grounds that Chicago and Detroit constitute a proper dividing line between the systems of North Central and Lake Central. He said that, while North Central is now better equipped to provide new service with its Convair 340 equipment, the carrier would still be unable to provide needed one-carrier service in the Ohio area.

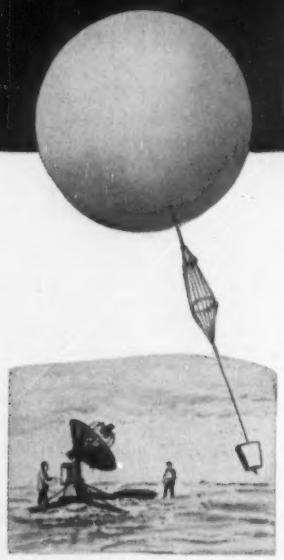
Piedmont, he said, would be in a position to provide Fairchild F-27 service before Lake Central, but failed to offer any nonstop Cincinnati-Detroit schedules in its brief except as an alternate schedule.

The examiner added the long stage lengths of some of Piedmont's flights also suggested that the airline is concentrating more on the development of long-haul beyond-area traffic rather than commuter services.

FLY WEATHER-WISE

These weather items prepared in consultation with the United States Weather Bureau

Upper Air Weather Stations dot the world. Observer technicians in all nations report upper air soundings in accordance with international standards and recommended practices.



Each upper air sounding requires carefully calibrated instruments. Large balloons carry Radiosondes up 50,000 feet to 100,000 feet. Radio signals send back information on temperature, humidity, pressure and, in many cases, on wind direction and velocity.

OPERATING in accordance with plans developed by the World Meteorological Organization (WMO) and the International Civil Aviation Organization (ICAO), a vast network of weather stations, generally about 300 miles apart, takes upper air measurements 2 to 4 times daily. Through international cooperation, the results of these measurements are exchanged on a world-wide basis and are made available to the aviation field and the general public.

Upper air soundings are made with balloons carrying RADIOSONDES which report temperature pressure and humidity at various levels. When available, special equipment also permits measurement of the upper winds at the same time. This combination of information allows meteorologists to analyze the complex structure of jet streams, fronts, tropopause surfaces, etc.

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Four U.S. International Airlines Ask Higher Share of MATS Traffic

New York—Four U.S. international airlines last week submitted a proposed contract to the federal government which in effect would place with them all Military Air Transport Service cargo and passenger business to points they now serve.

The airlines—Northwest, Seaboard & Western, Trans World and Pan American—submitted the proposal to handle all government traffic to the Departments of State, Treasury, Defense, Agriculture and Commerce, the Federal Aviation Agency, the United States Information Agency and the International Cooperation Administration. But a greater share of MATS traffic is a key goal.

Primarily aimed at cargo, the plan calls for lower rates to the government but the exact figure was not specified. This question is under discussion with the tariff and regulatory staffs of the Civil Aeronautics Board. As a corollary, the airlines plan to reduce civil cargo tariffs to the proposed government level.

One effect the proposal would have, if accepted, would be to eliminate supplemental and contract and possibly other carriers from parts of MATS contract business, and spokesmen for the four airlines see possible grounds for objection from Congress.

This situation was spotlighted by a complaint from TWA President Charles S. Thomas at a luncheon here recently over the loss by TWA of a MATS transatlantic contract to Overseas National Airways.

Thomas objected to competitive bidding for these contracts which he said was responsible for price cutting to the point where the larger certificated international carriers could not compete.

The case cited by Thomas was the award last September of a $23.9 million MATS contract to Overseas National for four Atlantic and Pacific round trip passenger contracts—for which Overseas National found it necessary to lease nine Douglas DC-7s from General Aircraft and Leasing Division of General Dynamics Corp. to supplement its fleet of four DC-6s. These are some of the DC-7s American Airlines "traded in" for its Convair 600s on order.

Five other carriers, Alaska Airlines, Capitol Airways, Hawaiian Airlines, Ltd., Seaboard & Western and Slick Airways, also were awarded MATS contracts then, and American International Airways, Inc., a contract carrier, was added later to bring the total contracts to $39.5 million.

A MATS spokesman said the contracts were awarded according to the Armed Services Procurement Regulations and in accordance with regulations which prescribe competitive bidding and that certain percentages of military business go to small business.

Pan American lost a Pacific contract it had held and one result was the diversion to commercial cargo runs of two of the four Boeing Stratocruisers it had used for the MATS contract. Their availability may have been a factor in encouraging Pan American to joining in lowered Pacific cargo rates (AW Nov. 9, p. 40).

Under the four-airline proposal, airlift capacity, personnel and facilities used to handle government traffic will be held constantly available by the scheduled airlines on call by the Secretary of Defense in an emergency. On request, 50% additional capacity would be provided temporarily by the airlines. This differs from the Civil Aircraft Reserve Fleet availability, which requires a declaration of a national emergency.

A spokesman for one of the airlines said that the carriers planned to accommodate possible variations in government requirements for capacity by an increase in commercial cargo business expected because of the reduced rates. These reductions would be possible because of the base firm government business would provide.

The airlines say that not only would the proposal permit them to acquire fleets of turbine-powered cargo aircraft but would also permit the retention of many skilled employes who will be displaced otherwise by the arrival of more efficient jet transports.

The proposed agreement would remain in effect indefinitely unless terminated on two years notice. It would have to be approved by Civil Aeronautics Board as in the public interest, and could be terminated at any time by CAB if it found the agreement no longer in the public interest.

Submission of the plan was in accordance with a recent CAB order, the airlines said (AW Aug. 24, p. 43).

System to Reserve Seat in 3 Sec.

New York—American Airlines plans to begin installation in 1961 of a new system-wide reservations system which will electronically handle individual passenger information as well as flight information and inventory control. With the new system, information stored in a central IBM 9090 computer will be available in seconds to agents in any city on American's route pattern.

Developed for American by IBM after six years of research, the system is expected to go into use during the last quarter of 1961. First point probably will be Hartford, Conn., or a city of the same size, to gain experience with the system. The central computer will be located in the New York area. By summer of 1962, most major cities will be joined to the system, with New York and Chicago linked in early 1962.

In a typical reservations transaction the airline agent selects and inserts in his console an air information card which lists flights, frequency, departure times and the like over the desired route. The agent, who may be located at any city in the system, then queries the central computer by pushbutton and receives availability information.

With a flight selected, the agent presses a "sell" button and the computer adjusts its inventory and prints a record of the sale on the agent's printer, in words. Return reservations can also be handled in the same way. Then the agent types such information as passenger's name and telephone number on the printer and the computer stores and acknowledges this information. Finally, the computer checks the record for completeness and advises the agent of omissions if any exist.

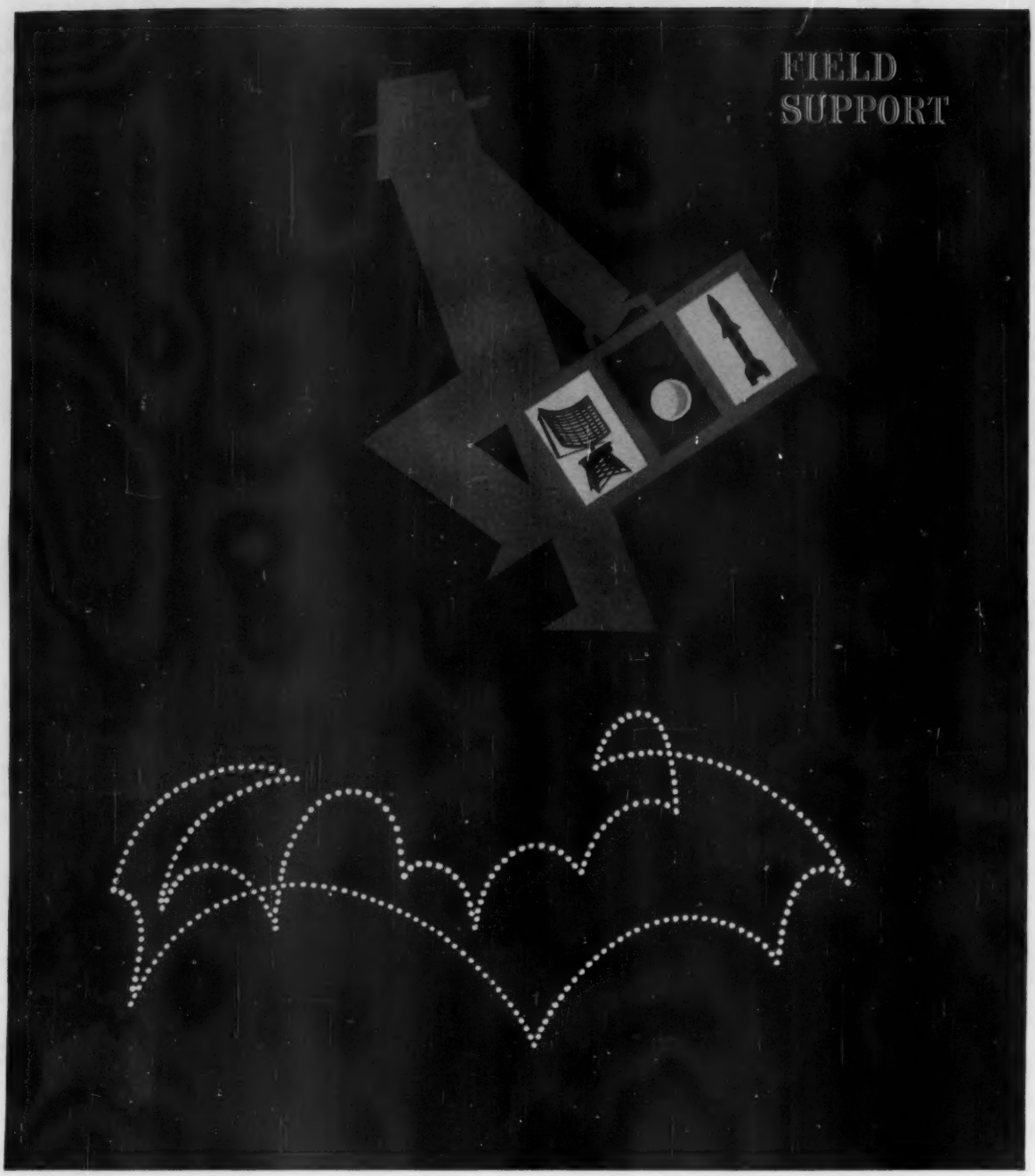
If a passenger's name is misspelled and the computer queried for his record, the computer will find the most likely name and present that record, with a note that the spelling is inconsistent.

By handling the passenger record including name and phone number, the computer thus eliminates the need for files of printed cards, one of the time-consuming elements of current reservations systems. Over-all, American says the system will cut the average reservations transaction time from 45 min. to three seconds.

Agent sets for the system are still under test by IBM, but the computer is already coming off the company's production line for other business uses.

Northwest Electra Order

Minneapolis—Northwest Airlines ordered eight long-range Lockheed Electras last week at a cost of $22.6 million, bringing the carrier's Electra fleet up to a total of 18. The additional eight turboprops are being modified to increase fuel capacity by 1,060 gal. and provide them with a 3,000 mi. range. Schedule calls for delivery of two Electras in May, two in June and four in July. Northwest expects to have the transports operating over the majority of its routes by early summer.



where's Charlie . . . Madrid? . . . Tokyo? . . . Sault Ste. Marie? Wherever he is, as a Bendix Radio Field Engineer, he's helping a satisfied customer get top operational return on equipment investment. Our Field Engineering organization—more than 1100 people strong—is world-wide in scope, quick in reaction. It is a vital element in Air Force Air Defense radar—a program for which we operate 12 depots, 10 of them overseas. It operates, maintains and supplies the satellite tracking network for NASA. Recently, we were awarded a contract for ground sub-systems for Project Mercury. For the best field engineering available—from black box repair to complete systems support—contact us at the following address.

Bendix Radio Division
GOVERNMENT PRODUCTS • BALTIMORE 4, MARYLAND

Bendix
AVIATION CORPORATION

Airline Traffic—September, 1959

	Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	725,143	543,777	73.7	1,913,129	1,033,136	9,813,560	65,021,725	64.1
Braniff	178,911	79,544	57.5	329,363	173,191	660,223	8,800,137	48.6
Capital	343,289	139,058	61.7	506,587	319,671	452,954	14,619,810	55.2
Continental	107,560	71,264	53.3	121,332	101,202	298,855	7,353,299	42.9
Delta	248,198	121,006	55.7	412,399	348,852	1,394,631	13,790,608	51.5
Eastern	707,546	363,474	49.24	1,009,593	567,459	1,567,363	38,139,402	40.44
National	130,165	72,919	48.5	257,946	70,978	548,176	7,926,531	41.4
Northeast	110,794	38,362	46.0	92,412	47,672	112,607	3,926,953	37.5
Northwest	164,749	127,693	61.0	544,787	283,588	1,442,551	14,534,599	53.2
Trans World	475,543	444,944	74.9	1,419,864	818,918	2,762,330	47,628,985	64.4
United	626,459	431,466	72.4	2,262,080	1,214,640	6,516,996	51,466,410	65.0
Western	153,495	85,638	61.1	307,036	94,383	311,641	8,924,085	52.6
INTERNATIONAL								
American	9,254	9,140	60.0	9,042	672	190,944	1,143,935	62.3
Braniff	4,245	8,165	54.8	21,977	.....	98,691	1,005,345	50.2
Caribbean Atlantic	28,480	1,939	66.2	1,667	.....	4,499	210,355	73.0
Delta	4,040	5,523	54.3	6,680	.....	33,102	653,425	47.2
Eastern	39,337	60,647	57.32	66,088	.....	135,308	6,425,758	54.68
Mackey	7,821	1,565	42.4	.....	.....	4,080	172,100	42.5
National	6,261	4,304	49.6	9,384	5,613	51,501	526,939	46.0
Northwest	17,665	32,444	57.3	1,200,477	27,347	977,276	5,620,858	58.3
Pan American								
Alaska	4,812	5,092	57.0	34,409	.....	171,158	758,267	59.0
Atlantic	133,182	191,643	77.4	1,264,108	.....	3,350,901	24,597,549	67.9
Latin America	103,801	122,761	69.5	399,042	.....	4,449,203	16,726,704	67.3
Pacific	30,536	125,182	81.1	1,261,606	.....	2,136,169	16,427,633	73.7
Panagra	12,241	17,558	66.2	68,615	.....	486,621	2,434,099	65.9
Resort	22	64	18.1	.....	.....	1,712,255	1,718,758	80.6
Trans Caribbean	7,612	12,217	82.5	.....	.....	377,127	1,364,041	79.1
Trans World	41,772	130,015	72.1	824,509	.....	2,146,063	16,332,789	69.8
United	10,782	26,822	74.6	125,569	.....	93,803	2,951,891	71.9
Western	5,023	7,811	70.2	9,491	.....	13,527	844,982	72.2
LOCAL SERVICE								
Allegheny	54,562	9,593	48.4	11,925	24,155	36,341	989,073	47.3
Bonanza	18,996	4,630	42.3	5,713	3,136	9,477	461,009	44.5
Central	13,870	2,679	37.2	6,719	3,759	14,748	281,873	34.0
Frontier	28,009	7,238	36.0	23,992	11,270	76,011	810,487	41.0
Lake Central	21,161	3,357	42.8	4,353	21,961	.....	347,690	46.8
Mohawk	49,863	9,853	53.8	11,287	19,099	19,935	991,718	54.2
North Central	88,264	15,806	47.48	34,608	55,619	44,210	1,670,166	48.76
Ozark	50,717	8,917	46.7	14,635	30,180	37,783	935,928	49.7
Pacific	43,433	9,847	55.2	14,435	4,512	7,621	966,112	54.0
Piedmont	43,471	9,114	48.4	11,958	16,453	22,940	924,628	49.6
Southern	19,689	3,589	37.5	8,646	9,170	17,155	379,298	39.5
Trans-Texas	26,027	6,138	37.6	19,461	10,900	44,349	662,491	38.9
West Coast	33,363	7,683	44.31	9,889	5,297	19,491	768,438	43.5
HAWAIIAN								
Aloha	26,800	3,932	58.2	2,484	.....	5,510	323,577	55.8
Hawaiian	36,532	5,389	55.2	3,225	.....	142,718	578,797	56.5
CARGO LINES								
AAXICO	.....	.....	.....	.....	.....	6,070,630	6,070,630	70.92
Aerovias Sud Americana	.....	.....	.....	.....	.....	565,637	565,637	86.0
Flying Tiger	1,812	8,100	100.0	42,275	103,710	12,371,532	13,327,566	85.2
Riddle								
Domestic	.....	.....	.....	4,146	29,068	1,407,780	1,440,994	75.5
Overseas	.....	.....	.....	4,645	.....	533,932	538,577	77.7
Seaboard & Western	288	1,175	100.00	397,224	.....	2,414,066	2,932,761	67.27
Slick	3,122	19,904	95.27	.....	.....	3,767,893	5,758,247	98.05
HELICOPTER LINES								
Chicago Helicopter	23,306	414	60.7	1,215	.....	.....	40,689	50.2
Los Angeles Airways	4,146	143.8	58.0	4,413	2,437	.....	20,603	58.2
New York Airways	11,848	218	54.1	1,155	756	622	23,380	53.0
ALASKA LINES								
Alaska Airlines	10,298	8,600	59.7	58,733	4,297	395,380	1,313,529	61.8
Alaska Coastal	5,295	579	61.1	4,049	.....	3,851	67,122	62.5
Cordova	1,402	241	35.7	5,312	.....	40,278	70,542	45.0
Ellis*	.....	.....	.....	.....	.....	.....	.....	.....
Northern Consolidated	2,803	906	48.4	35,651	.....	62,903	197,821	63.4
Pacific Northern	11,331	10,561	48.7	106,575	7,476	324,995	1,585,333	59.5
Reeve Aleutian	1,504	1,224	39.1	44,158	.....	91,879	269,456	63.0
Wien Alaska	3,519	1,131	28.3	39,134	.....	176,704	331,838	50.2

*** Not available.**
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Medics Stress Seniority Rule Problems

By Russell Hawkes

Santa Monica, Calif.—Medical problems of transition to jet airliners were somewhat intensified by the Air Line Pilots Assn. strike last winter and seniority rules which sent older crews into transition with little time remaining before the start of service, American Airlines Medical Director Dr. K. L. Stratton told the University of the City of Los Angeles aviation medicine symposium here.

Upset stomachs and other signs of tension under the pressure to complete training in minimum time have been attributed at least partly to the age of the first crews assigned to jets. Younger men learn more rapidly, Stratton believes, and they would have shown less evidence of strain under the circumstances.

The pilots' strike reduced the time available for transition training before initiation of jet service.

Equal Learning

Dr. Stratton said there is no reliable evidence that older pilots cannot fly jet transports as well as younger ones, but their transition period should be stretched to obtain equal learning without increased stress. At first, some crews were completing transition training barely in time to fly new airplanes away from the factory. In this limited-time situation, there were some upset stomach cases and other evidences of tension.

These rapidly disappeared as better training became possible. Unlearning of conflicting propeller aircraft techniques seemed easy enough for all pilots, regardless of age or experience.

After 10 months of experience with the Boeing 707, Dr. Stratton reported no medical deterioration of pilots and flight engineers due to stress of flying the jets.

However, the workload appears to be great enough to justify the four-man crew used by American. Eye strain is reduced by better window layout and more effective red lighting of cockpits at night. Cockpit loudspeakers eliminate the annoyance of having to wear a headset continuously. Pilots still put the headsets on for any necessary communication but monitor the loudspeaker until they hear their call sign or make a transmission.

Regarding complaints of menstrual irregularity by stewardesses on jet routes, Dr. Stratton said there is not yet enough experience accumulated to tell whether the percentage of disturbances is significantly higher than for any group of women in the 20-30 age bracket. It is true, as stewardesses complain, that there are more passengers to care for and less time on jet runs, but there are also four stewardesses rather than two.

Dr. Ludwig G. Lederer of Capital Airlines commented that this is a cyclic problem for airlines which recurs whenever new equipment being phased in is very different from the old equipment.

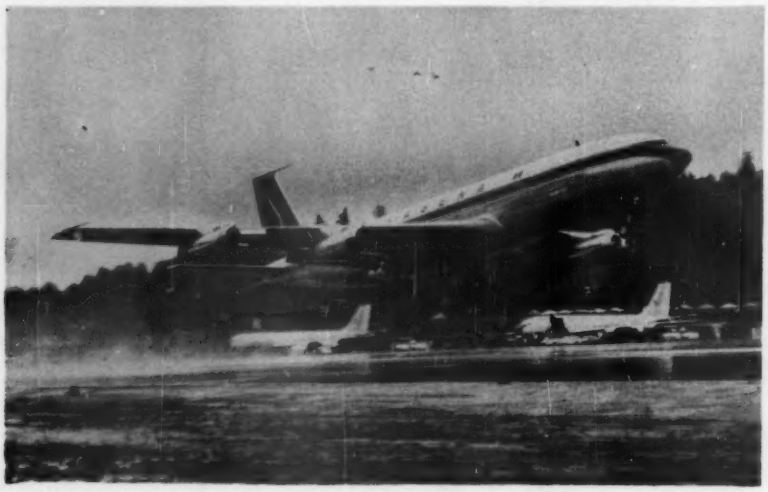
He cited the transition to pressurized aircraft and Capital's transition to the turboprop Vickers Viscount. In the past the problem has disappeared after a few months. Dr. Stratton recalled an instance in which replacement of incandescent lighting by fluorescent lighting in a large office caused a temporary increase in complaints of menstrual irregularity by clerks and typists. In a later rearrangement of the office, incandescent lights were temporarily installed and the number of complaints rose again.

Pilot Age

United Air Lines Medical Director, Dr. George J. Kidera, defended arbitrary pilot retirement age criteria, though acknowledging there is no consistent correlation between chronological and physiological age. He pointed out that the probability of sudden incapacitation increases with age. In many cases its approach is undetectable or irreversible.

Studies by United of pilot physical examination reports as far back as 1937 show that examination forms no basis for the prediction of disease or defects in later life.

In the case of psychological incapacitation, a study of earlier personality tests and psychiatric interviews showed no clue to the approaching collapse.



Sabena 707 Intercontinental Makes First Flight

Sabena Belgian World Airlines' first Boeing 707-320 (AW Oct. 26, p. 47) makes its maiden flight at Renton, Wash. After a 2-hr. flight a landing was made at Boeing Field, Seattle, where the aircraft will be based for final tests. Sabena's five 707-320s will have 134-seat capacities.

Chief Raps Aeroflot Training Practices

Moscow—Crackdown on Aeroflot practices ranging from pilot training to passenger service is being spearheaded by the chief of the state-owned airline, Col. Gen. of Aviation Yevgeny Loginov.

The Aeroflot chief also has charged airport operators with being "seriously negligent" in providing services for travelers (AW Nov. 9, p. 50). In an article published in the magazine Civil Aviation, Loginov called for more pilot instrument training, improved preflights, and "discipline." Loginov, who replaced Marshal Pavel Zhigarev as the Aeroflot chief, said because of Aeroflot's fast expansion "every year we must carry 31% more than the year before." He told airline personnel from baggage carriers to aircraft commanders to turn in more polished and competent performances.

Pointing out that winter navigation now is beginning in Russia, he cited examples of pilots who finished the summer without making a single bad weather landing. Loginov said these pilots explained they only get one training day every two months, "so it turns out pilots make mistakes in the air not

because they don't know or don't like flying but because they lose their skill by insufficient practice in bad weather landings." Loginov added: "It is the fault of division leaders who dont care. It is time to understand pilot qualifications should be looked at not only for initial qualifications but also for training, the number of bad weather landings and trips made under instrument flying conditions."

Preflight preparation, he said, sometimes is inadequate. He mentioned a pilot in the Ukraine who crashed after taking off in an overloaded crop sprayer aircraft. "It is our sacred duty to carry passengers according to the timetable," Loginov stressed. Referring to passenger service, he demanded that baggage handling facilities be improved and said "sending baggage to the wrong address must stop. If baggage is lost, it must be treated like a special accident and blame must be strictly apportioned."

Passengers have complained that they cannot get exact information from information bureaus and "this must be improved."

Turning to ground equipment, he said fuel trucks must be painted one color and aircraft tugs another. To eliminate crowding at airports, Loginov said city terminals must be constructed. He reported this is being done now in Moscow, Leningrad and Kiev.

With winter coming, the Aeroflot chief said hotels and airports must prepare for grounded passengers, especially on the Siberian routes. Touching on Aeroflot expansion, Loginov made these points:

- **Nearly 50% of Aeroflot** traffic in August was carried on jets and turboprops.
- **During the first eight months** of this year, Aeroflot carried 48.5% more domestic traffic than in the previous year.

British to Support Eurocontrol Studies

London—Britain has pledged support for European plans to study creation of an integrated air traffic control system covering upper airspace in northwestern Europe.

New Minister of Aviation, Duncan Sandys, informed a meeting of common market directors-general of civil aviation at Brussels that Britain wanted to join in a study of legal, technical and other problems involved.

Common market countries have been working on a project for an integrated flying control agency known as Eurocontrol to provide an automatic electronic system to reduce collision risk between civil and military aircraft at high altitude.

The Spoken Word—Part IV

Terminal control today is almost exclusively a function of voice communications. In the final analysis, it is the airport and its attendant approach facilities which determine the capacity of the air. It is no secret that airport delays continue to get worse. The average landing rate over a given interval of time is sometimes used to prove that airports are efficiently operating at a high capacity. But with proper voice communications we could do much better—we could achieve a higher "constant velocity" with greater safety.

IFR-VFR Priorities

Another area in which work is needed concerns the relative priority between IFR (Instrument Flight Rules) and VFR (Visual Flight Rules) traffic. For instance, should the aircraft which filed a flight plan and followed an airways clearance (IFR) be delayed for landing VFR traffic? Or should the VFR flight be held for the IFR aircraft on instruments?

This one particular item has already reached the point of open warfare when the two types of traffic conflict in the terminal area. Long harangues and lost tempers are continually heard with both parties claiming injustice in handling as they attempt to argue it out on the air. This further congests the frequencies, a factor which further reduces the flow of traffic.

Airport Dogfights?

During periods of low weather such conflicts do not occur—everyone is IFR. But pilots are beginning to wonder why, when it is not absolutely necessary, should they go through the rigmarole of filing a flight plan and adhering to a clearance in order to be held for the landing of a pilot who took off, flew and arrived completely unannounced? Of course the VFR pilot has exactly the same query. If this particular problem is not solved, our entire traffic problem is going to be resolved by dogfights around the airport.

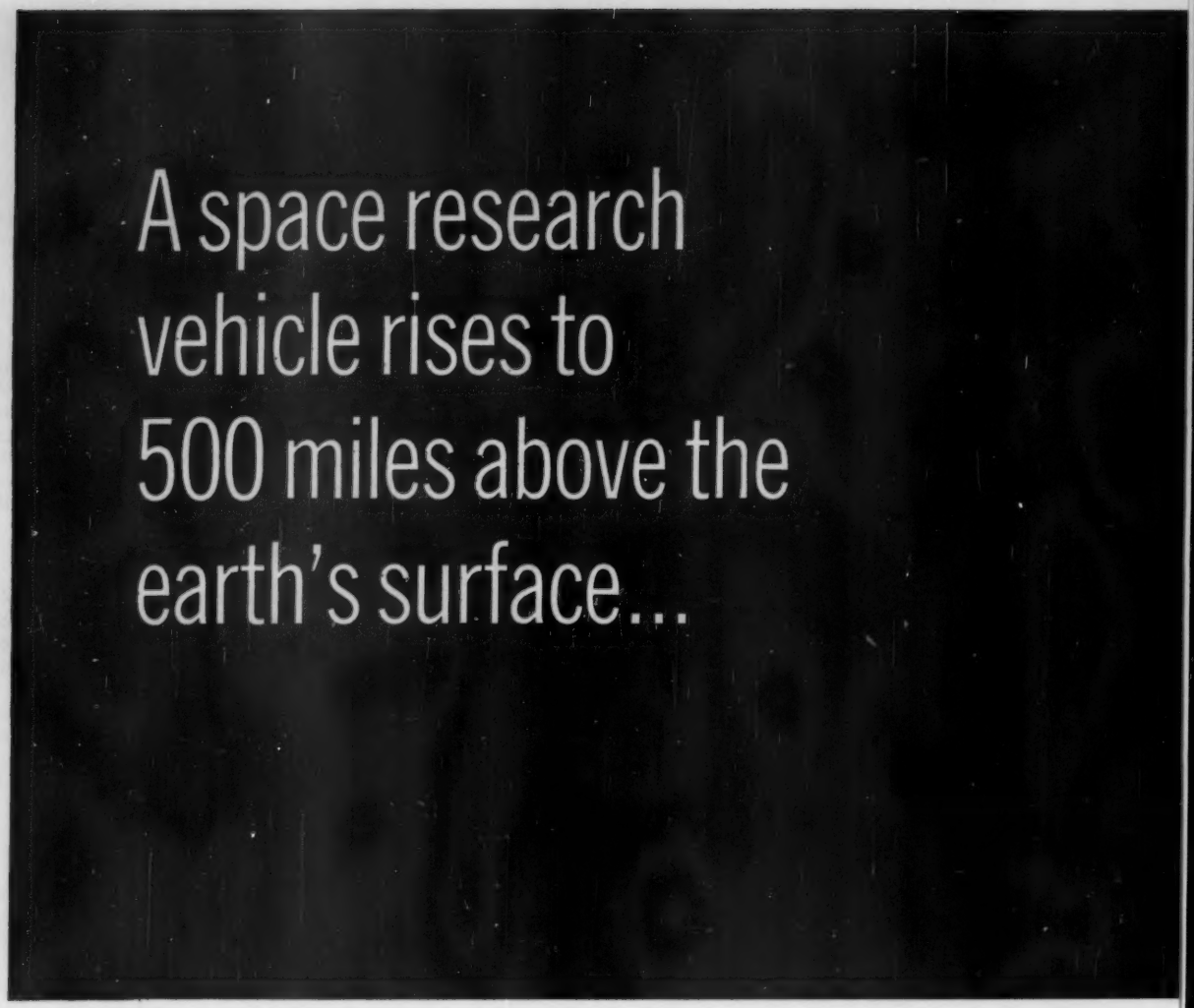
A variation of this occurs when an aircraft completes an entire IFR flight, including an instrument approach, then finds it must circle the airport to land behind VFR aircraft. Does this constitute unilateral cancellation of the pilot's ATC clearance without his consent? And does it have the required safeguards of a legal clearance—such as what to do in case of radio failure, etc?

Tower Operating Policies

Some of these problems are partially solved by the operating policies of particular towers—and it should be noted that there probably is no perfect answer. At LaGuardia Field, for instance, arriving aircraft must make their first radio contact with LGA Approach Control. At this point, 30 or 40 mi. away, sequencing begins—regardless of weather conditions. Aircraft are held, climbed, descended, slowed or speeded as necessary to arrive at a just and equitable landing time—again insofar as this is possible.

At Washington National no such system exists. Except in totally IFR weather, Approach Control contact is not rigidly required, the approach controller never interferes with the flight of the aircraft, makes no attempt to sequence, gives practically no traffic information and rarely volunteers weather information. Proper handling at this point could reduce the work load on tower frequencies and result in greater airport capacity.

Several Cockpit Viewpoint columns back, the contention was made that voice communications would continue to be our mainstay in the control of traffic for many years to come. Let us hope for action soon on the spoken word.



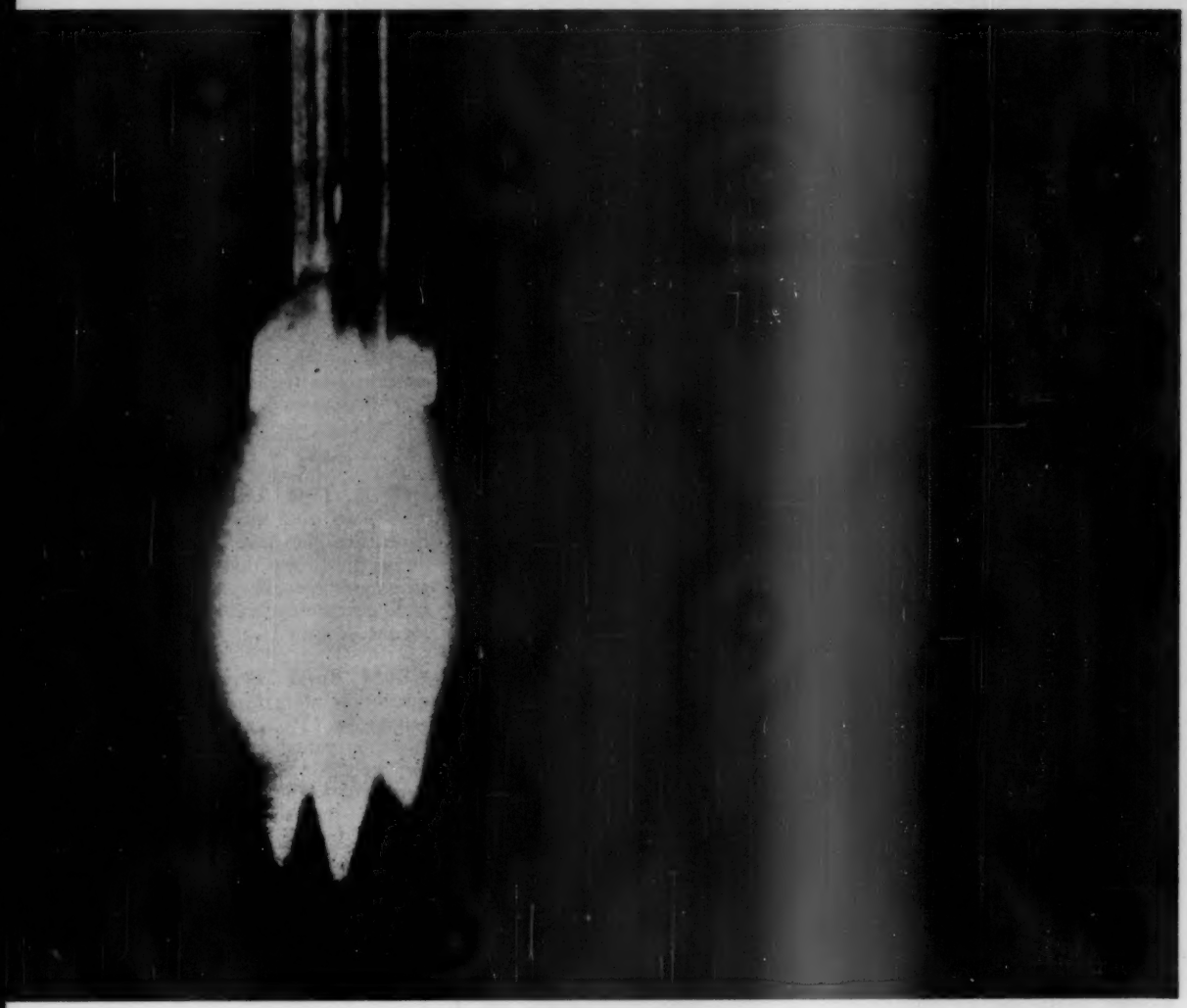
...AND BRISTOL SIDDELEY

One of the largest manufacturers of motive power units in the world, Bristol Siddeley Engines Limited produce the Gamma.

A liquid propellent rocket engine, the Gamma powers the Saunders-Roe Black Knight, Britain's highly successful space-research vehicle. An extremely reliable powerplant, the Gamma produces a total sea-level thrust of 16,400 lb (7,438 kg) and nearly 19,000 lb (8,618 kg) outside the earth's atmosphere, for a total powerplant weight of only 700 lb. The Gamma sends Black Knight over 500 miles into space above the Woomera rocket range in Australia.

Since Bristol Siddeley's rocket division began work in 1946, it has developed a wide range of components. By combining these components in single or multi-chamber layouts, thrust requirements from 500 lb up to very high figures can be met.

BRISTOL SIDDELEY ENGINES LIMITED



SUPPLY THE POWER

The Bristol Siddeley Orpheus, the world's most advanced lightweight turbo-jet engine, powers this Fiat G 91 standard lightweight strike fighter (chosen by NATO). The Orpheus is in service in 6 different aircraft and is specified for 8 others.

Bristol Siddeley Maybach diesel engines are designed for a wide variety of applications and range from 200–3,000 hp. Here is a British Railways diesel hydraulic locomotive powered by two Type MD 650 engines, developing a total of 2,200 hp.

The Bristol Siddeley Proteus powers the Britannia airliner. Four Proteus give this 130-seat aeroplane a speed of over 400 mph—a range of over 5,000 miles. Britannias are in service with twelve airlines and with RAF Transport Command.

AIRLINE OBSERVER

►Watch for an order for additional Boeing 707-320 intercontinental turbojet transports by Australia's Qantas Empire Airways. Pressure on the company to buy de Havilland Comet 4s apparently has been resisted successfully.

►**British government will increase borrowing powers of British Overseas Airways from $448 million to $504 million and British European Airways from $168 million to $266 million for a total increase of $154 million.**

►U.S. airlines were flying more jet planes and jet passenger miles as of last June than those of any other country, according to a survey conducted by the Civil Aeronautics Board. During June, the survey reported that four U.S. airlines flew 3.1 million jet miles, or 45% of the world's total. However, according to the Board, the single Soviet airline, Aeroflot, accounted for 35% of the world jet transport mileage. Most extensive network of jet routes was operated by the United Kingdom—32,754 mi. U.S. carriers operated 26,055 mi., Aeroflot 21,096 mi. Aerolineas Argentineas, only Latin American jet operator at the time of the survey, had 16,640 mi. of jet routes.

►**Lufthansa German Airlines proposal to eliminate foreign carriers' cabotage rights within the West German Federal Republic will be turned down by the German government. At present, foreign carriers—including Pan American, British European Airways and Air France—have rights to cabotage provided flights do not start within two hours in either direction of a Lufthansa flight on the same internal route. Lufthansa, in asking for a restriction of these rights, claims that cabotage amounts to discrimination and has resulted in a heavy loss of revenue. Recently, the airline reported a 1958 deficit of $7.64 million, largest in the company's history.**

►Russia is only planning five and one-half hours daily aircraft utilization for its Tu-114 turboprop transports during their initial period of scheduled service. However, Soviet economists say 20 Tu-114s flying 2,000 hr. annually with passengers now handled by long-distance trains "will save enough travel time each year to equal the addition of at least 10,000 men to the nation's work force."

►**Trans World Airlines has filed a complaint with the Civil Aeronautics Board charging Allegheny Airlines with unfair and deceptive practices by allowing transferable use of commuter-type tickets between Pittsburgh and Philadelphia. In its complaint, TWA claims that, although the commuter tickets are not transferable under the terms of the tariff, Allegheny is conducting a campaign in which prospective purchasers are advised that "coupons are transferable." TWA earlier charged that the Allegheny plan is discriminatory (AW Oct. 19, p. 47).**

►Northwest Orient Airlines has installed an organ on one of its Boeing 377 Stratocruisers which operates over the New York-Chicago-Minneapolis route on a trial basis to get passenger reaction to organ music played en route. The organ, which weighs 190 lb., has been modified to fit into the plane's seat tracks. Carrier is now hiring organists to man the musical instrument.

►**Swissair will offer a la carte service to first-class passengers on transatlantic flights. Passengers will fill out forms 48 hr. in advance of departure time to select their dinners from menus which will include up to 10 main courses, and five desserts.**

►Argentine government has refused to allow Pan American World Airways to operate more than one weekly jet flight between New York and Buenos Aires. As a result, Pan American has been terminating its second jet flight at Ascuncion but, because of the relatively light traffic to and from that city, the airline requested an exemption from the Civil Aeronautics Board permitting an extension of the service into Montevideo to help compensate for the loss of revenues caused by the Argentine exclusion. Last week, the CAB granted the airline a one year exemption authorizing the Montevideo service.

SHORTLINES

►**British European Airways** is scheduled to take delivery of two Comet 4B jet transports from de Havilland Aircraft Co. this month almost two months ahead of schedule. BEA has seven Comet 4Bs on order with de Havilland and is scheduling operations for Apr. 1, 1960.

►**Chicago Helicopter Airways** reports it carried 165,132 passengers during the first 10 months of this year, a 79.7% increase over the same period of last year. Passengers carried during October rose 91.1% over October, 1958, to 22,265.

►**Flying Tiger Line** realized third quarter net earnings of $443,690, a decline from the $896,150 net earnings during the same period of last year. The all-cargo carrier blamed reductions in U.S. government contracts as a reason for the decrease.

►**KLM Royal Dutch Airlines** third quarter operating revenues totaled $44.3 million, a 12% gain over the corresponding period of last year. The carrier reported net earnings for the period of $4 million, a 16% increase over the third quarter of 1958. Nine months' total operating revenues were $107.8 million while net earnings for the same period were $3.4 million, 7.6 and 2.8% increases respectively.

►**Los Angeles International Airport** believes revenues will be increased by $300,000 or more a year as a result of voluntary adjustment of landing fee contracts with five major airlines. The new rate is 10 cents per 1,000 lb., a more than 100% increase over the old rate of 4.6 cents. Affected airlines are American Airlines, Pan American World Airways, Trans World Airlines, United Air Lines and Western Air Lines.

►**Mohawk Airlines** has purchased a fifth Convair 440 airliner from Convair Division of General Dynamics Corp. for approximately $700,000.

►**Pan American World Airways** reports it has flown more than 210,000 passengers on its fleet of Boeing 707 turbojet airliners during the first year of operation ended Oct. 26.

►**Vickers-Armstrongs** has sold a Viscount V. 745 series turboprop transport to Philippine Air Lines. This sale, including two Viscount V. 784s, brings the airline total orders to three and Vickers sales to 408. The new Viscount will be operated on PAL's Hong Kong and domestic de luxe schedules.

New horizons in infra-red... by Bulova

Bulova designer-engineers can help you from concept to production

Bulova infra-red, camera, TV and radar techniques are being combined with Bulova analysis and display systems for defense and industry.

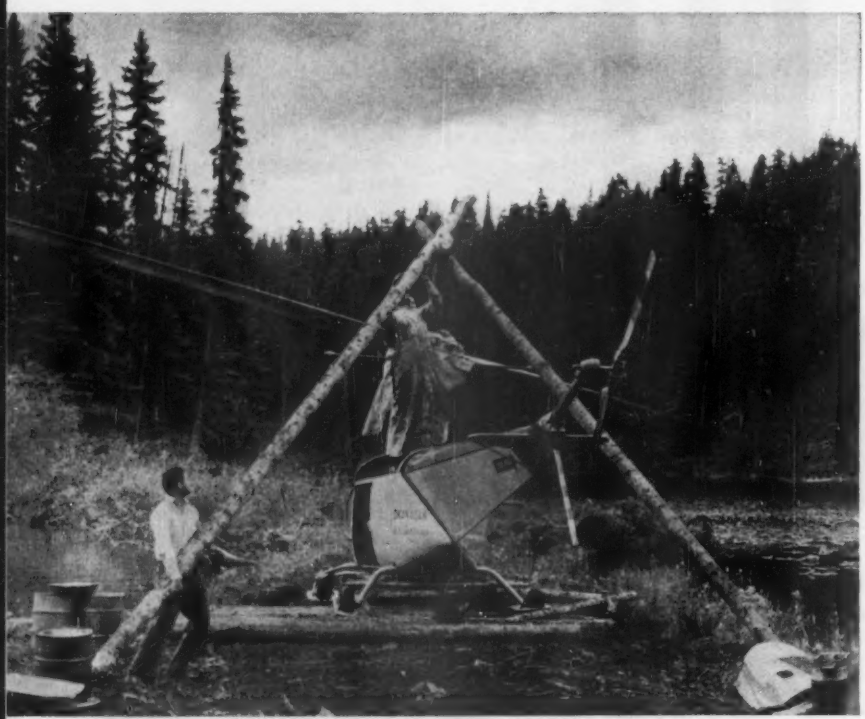
Bulova infra-red R & D extends to fire control systems, filters, reticles and thermistor bolometers, as well as advanced work in mosaic and photoconductor cells. Here is a proven capability ready to assist you in any area of IR development from black body emanations through detection to final display.

Experience in precision design and precision manufacture is the Bulova tradition, the Bulova capability. It has been for over 80 years. For more information write—

Industrial & Defense Sales, Bulova, 62-10 Woodside Ave., Woodside 77, N. Y.

BULOVA

LANDING PLATFORM was built in rugged mountain country near Downier Creek, B. C., to service a mining company operation. The helicopter operators often have blasted landing areas out of rock ledges during the freight-passenger hauls into the mountains.



PREPARING a block and tackle rig, Okanagan crew prepares to make an engine change during the early days of Okanagan's forays into the bush country of Canada.

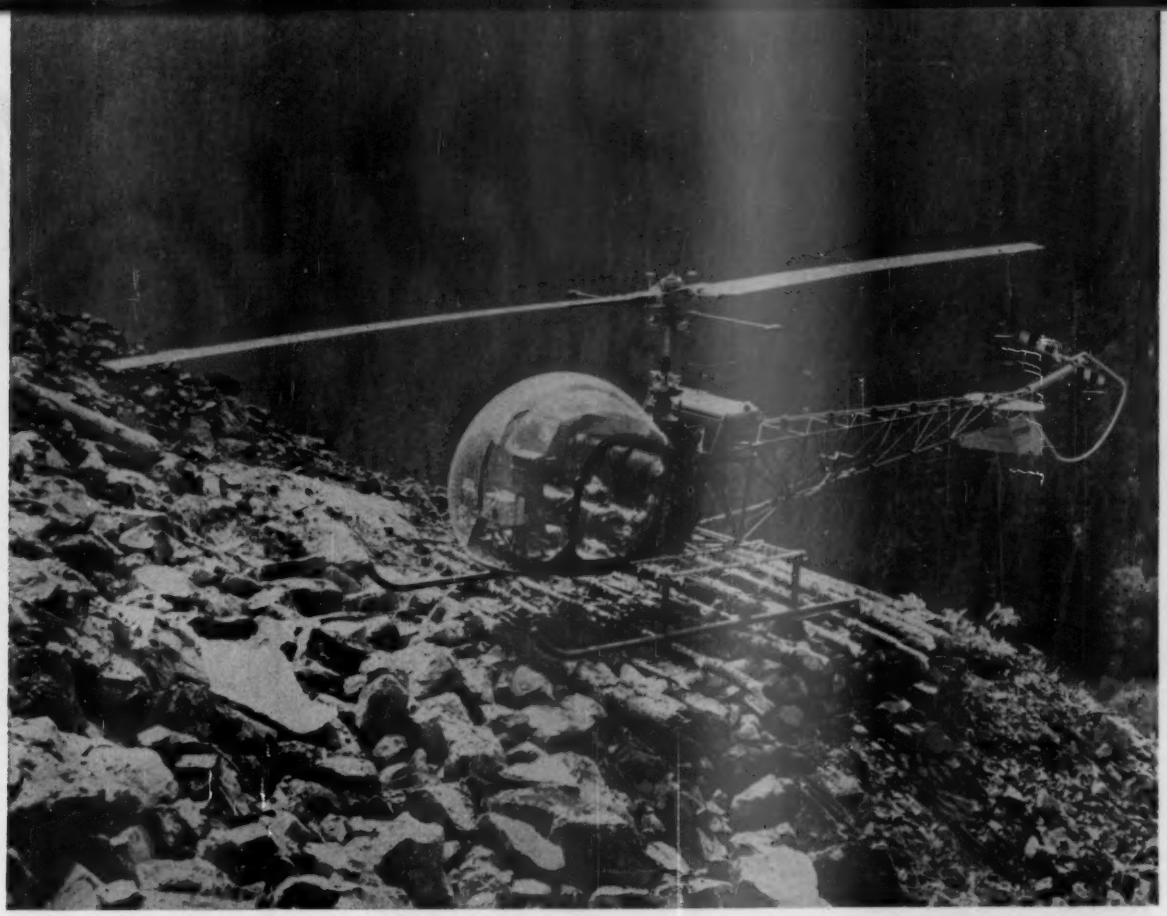
Okanagan

By Richard Sweeney

Vancouver, B. C.—Pioneers in developing the approach, landing and take-off techniques which made mountain operations feasible with helicopters, Okanagan Group here has grown to the largest rotary winged aircraft owner-operator firm in the world.

Okanagan's growth in 12 years to where it can keep busy a fleet of 37 helicopters—one Sikorsky S-58, six Sikorsky S-55s, two Bell 47Js, four Bell 47G-1s and 24 Bell 47G-2s—is based on a company philosophy that those who fly and maintain the machines are important. Customers see these crew-teams doing the job fast and efficiently. Results: the helicopter crews are in the best position to sell Okanagan's services on a repeat basis to existing customers and build up good will to attract potential customers.

In addition to the 37 aircraft now owned, Okanagan has bought two more Sikorsky S-58s, which were to be delivered during October. The company also operates 14 Royal Canadian Air Force Sikorsky S-55s, under a contract



BELL helicopter makes a landing on a temporary log platform in mountain country; this is a typical landing site for mountain work. The company today operates up to 54 helicopters on a variety of missions, ranging from haulage of freight to power and pipeline patrol.

Copes With Helicopter Mountain Flights

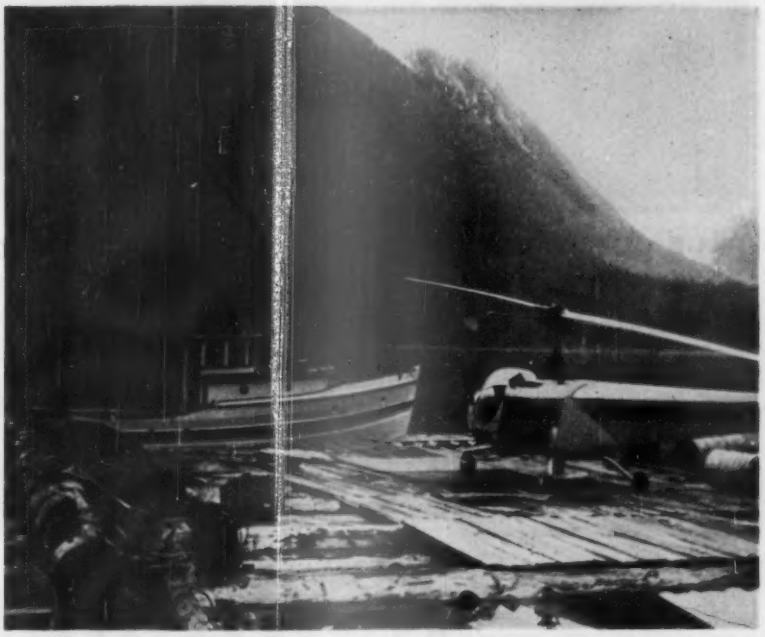
to supply the Mid-Canada Radar Defense Line. All told, the company operated 54 machines this past summer.

Current operations consist of conventional helicopter work, freight and personnel hauling, plus patrols of pipelines, powerlines, etc. However, two future prospects are under consideration by Okanagan in the passenger field.

Omega Order

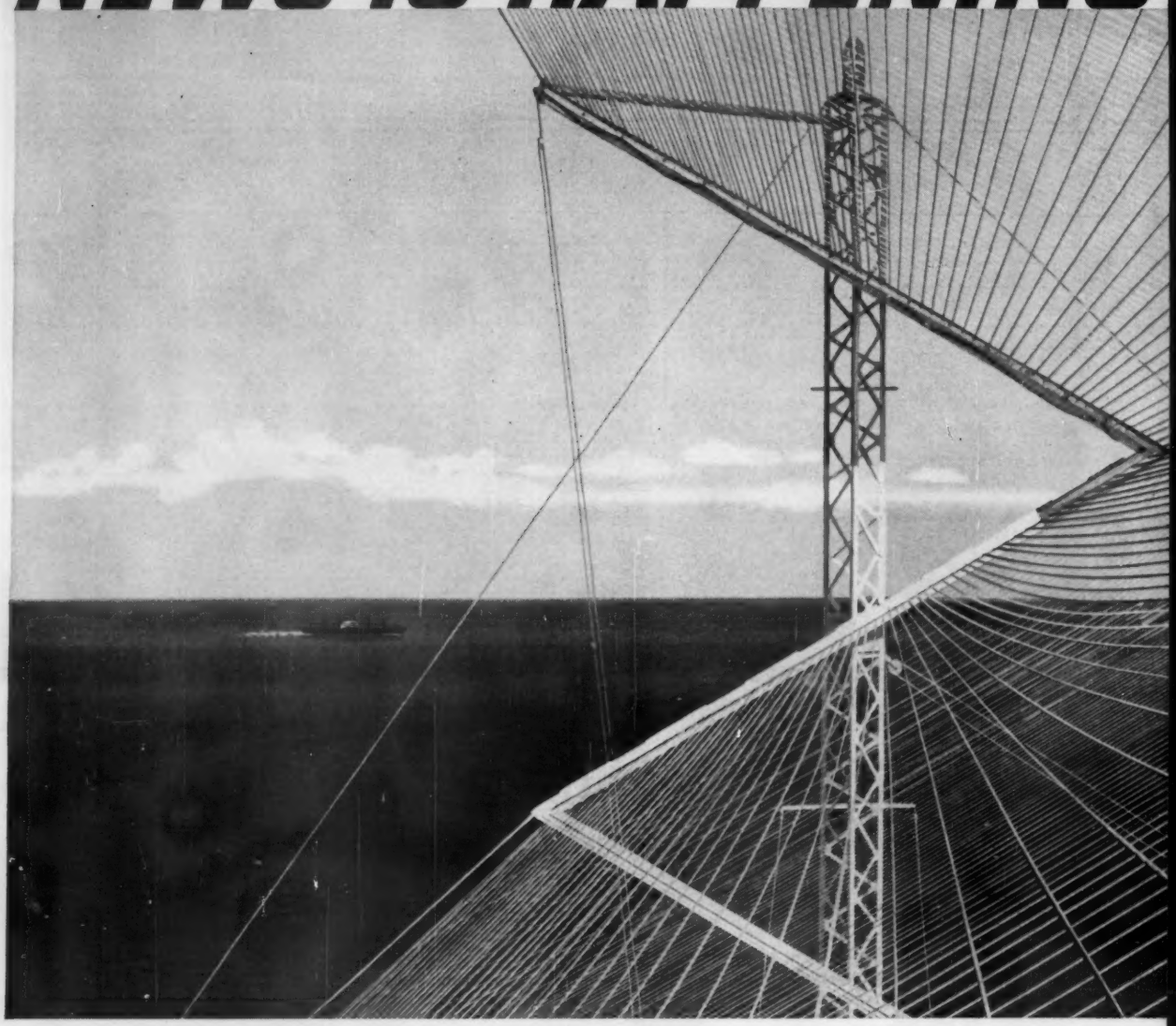
The company has ordered three Omega BS-12D twin-engine, single rotor helicopters with about 1,000 lb. payload over a 100 mi. range carrying three to four people plus pilot (AW July 27, p. 41), and with these or its Bell machines may start a service known as Copter Cabs. In this, Okanagan is seeking to sell various business firms blocks of time with the helicopter, to be used for executive transport or high priority materiel movement.

Under this system, which has been used in the U.S. in several instances with fixed wing operations as well as rotary wing, the leasing firm buys a certain amount of flight time in a given period, perhaps per month or three



BELL B-3 helicopter is shown on a rough landing platform at Palisades Lake during Okanagan's early days. Company since has expanded to several groups.

NEWS IS HAPPENING



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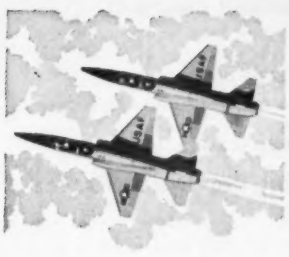
AT NORTHROP

NEWS FROM OTHER MEMBERS OF THE NORTHROP FAMILY



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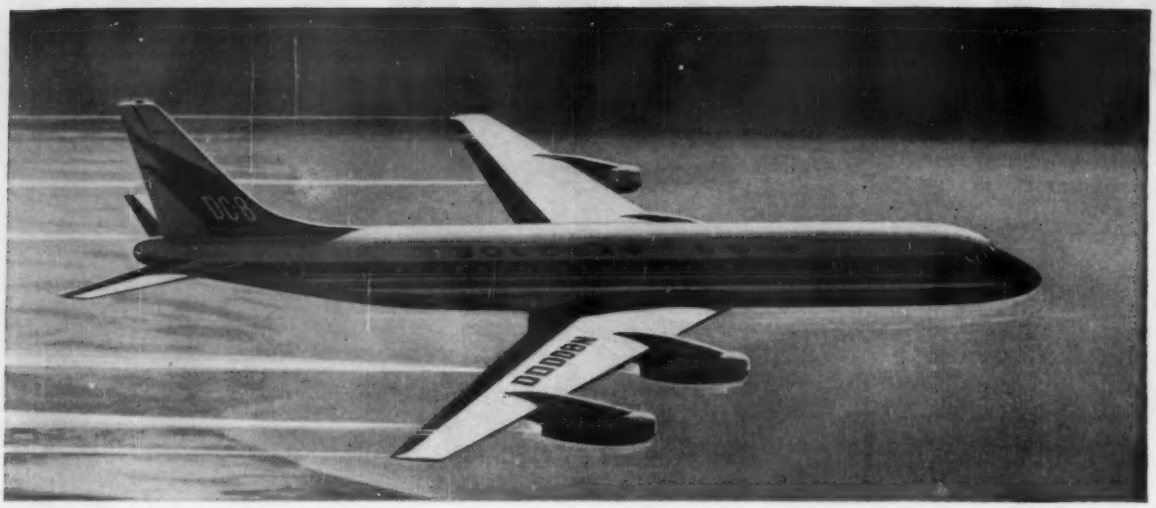

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months or six months, to be used however the company wants. Gathering enough clients would enable Okanagan to keep one or more machines occupied in this enterprise all year around.

The Omega purchase is not tied to the passenger deal; there are plans for using these machines in the bush.

Second passenger idea has its roots in a firm order for one Fairey Rotodyne VTOL, plus options on two more. This machine, for delivery in about 1963, should gross about 48,000 lb., be able to carry 70 persons at a good speed and operate in all weather conditions from city center to city center. Intended route is the Vancouver, Victoria and Seattle triangle, to which this aircraft seems well suited, Okanagan feels. The planes would cost about $3.6 million and would be able to make the 62 mi. run for a fare of about $10 per passenger, at a cost approximating 4½ cents per passenger mile. Powerplants would be Rolls-Royce Tyne turboprops.

Powerline Work

Although the company's activity usually is confined to Canada and parts north, last summer the S-58 was used by Southern California Edison Co., in installing 15 powerline transmission towers near Palmdale, Calif. This came about when Southern Cal-Edison, which pioneered powerline erection using helicopters (AW Nov. 4, 1957, p. 122), tried throughout the U.S. to secure an S-58 for the work but none was available. Okanagan was contacted and did the job with Federal Aviation Agency permission to operate in the U.S. and also performed the work at less than the estimated cost.

Okanagan started in 1947 when former RCAF pilot Carl Agar convinced fruit growers of the Okanagan Valley, northeast of Vancouver, that a helicopter would be excellent for spray/dust operations on their fruit trees. With Agar, as the engineer (mechanic) half of the team, was Alf Stringer.

Growers subscribed enough funds to buy a Bell B-3 open cockpit machine, with Douglas Dewar as the largest single subscriber. After the machine was bought and tried out, it was found that due to terrain and the small blocks of various kinds of trees, the rotary winged aircraft was just not the right one for this work in this area.

In 1948, the operation was moved from Okanagan Valley down to Vancouver, and the helicopter was used to spray mosquito-infested waters following a flood and also to spray a large Christmas tree preserve.

After this, the Topographic Division of the Department of Lands and Forests of the B. C. Provincial Government approached Okanagan to see if the helicopter could be used in its survey work in the mountains.

It was at this point that Agar began to develop the mountain flying techniques which have made both him and Okanagan famous. It was requested for this survey that Agar land at a site which was 5,300 ft. above sea level. The spot chosen was a small lake, about 145 ft. across, covered with snow and ice. The small lake was situated on the side of a mountain, in a pocket. The lake did not completely fill the rocky enclosure, leaving a lip which projected about five to 10 ft. above the surface of the water. The side of the mountain from which this small lake and it pocket projected had a slope of from 45 to 60 deg.

Although it was during August, the snow and ice were plainly visible. However, the quality of the ice, that is, whether it could hold the helicopter or not, was the big question.

Up to this time, conventional helicopter technique called for assuming a predetermined rate of descent along with a rate of forward travel which resulted in a relatively steep approach to landing. However, for this situation, Agar felt that a flat approach to the lake would be best. In addition, there was the problem of engine power available at this altitude.

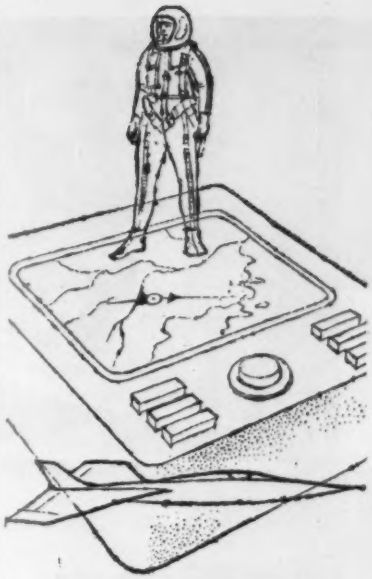
Agar started making approaches toward the lake along a relatively flat path. This way, he would start a distance out from the lake and slightly above it, approach the lakes with a fairly low forward speed, and almost zero rate of descent. This gave him the opportunity, should the need arise, to bank away from the lake and be headed downhill, in order to gain flying speed. In essence, this became a "down-and-out" escape route.

Smoke Flares

Altogether, Agar made seven fly-bys at the lake before making his first landing attempt. He used smoke flares to ascertain the wind direction. His approach flight path slope ratio was approximately 7 to 1. On the next to last approach he slowed the helicopter to 5 mph. forward speed, and figured that on the next pass he would reduce forward speed to zero and touch down gently.

Flying the helicopter in along the flat trajectory, at a very slow forward speed, Agar allowed the machine to settle gently onto the snow covered lake surface, lowering the collective pitch a little at a time.

When the helicopter had settled completely, he left the engine running, got out, smoked a cigarette or two, and then took off again. In the rim of the pocket which held the lake, there was a V-notch. The helicopter's nose had been pointed toward the notch and as he flew the machine out the rotor blades were just slightly above the rim



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of the wall, while the helicopter fuselage passed through the notch itself.

This was the start of the mountain flying techniques which have been copied by military and civilian helicopter operators throughout the world. It is the flat approach trajectory, in combination with a very slow forward speed.

Other parts of the approach technique include reducing the forward speed to two to three miles per hour as the helicopter approaches the landing pad and altitude is reduced to approximately one foot above the surface. A very slow or zero forward speed is established and then the helicopter is allowed to settle onto the pad, in a nose-high attitude reminiscent of a fixed wing airplane landing. This requires development of technique to prevent bending and breaking tail rotors.

When training new pilots, Okanagan instructors do not now specify an exact approach angle. Rather, each pilot is allowed to select the one he feels most comfortable with, and can handle best which falls within the acceptable limits.

Second big trick in mountain flying with helicopters is finding the wind, and, having found it, learning to cope with it. The wind and flat approach are two major techniques which are taught new pilots in Okanagan's training program. In addition, these facets are stressed in Okanagan's training courses for others, such as the U.S. Army, French air force, and various civilian government agencies.

Side Approach

In addition, the method has resulted in use of a side approach in wind; that is, the helicopter approaches angled sideways to the wind, traveling somewhat laterally. This way, the pilot is always ready to turn down and away in case of emergency. Among items on the forbidden list of helicopter mountain flying is climbing up slope into a wind. Also, the technique calls for making very wide, flat turns, rather than steep, short radius turns.

The rate of closure onto the pad is important in the Okanagan mountain technique. The actual rate of descent is somewhat secondary and the rate of forward speed is one of the most important phases. Apropos of final approach and landing technique importance, it has been found, according to Okanagan, that nine out of 10 accidents in helicopters in general occur under 10 mph., and of this, the biggest percentage occur under 5 mph. In addition, there are even more that happen either on the ground or in a low hover.

After Agar had satisfied himself over a period of time, as to the efficiency and safety of the flight technique he had evolved for landing on the sides and tops of mountains, in October,

THE GRAND CENTRAL REPORT

Solid propellant rocketry is an ancient art; but only a startling new technology permits us to build the huge, high performance solid propellant motors that propel today's missiles and research vehicles. Large solid propellant rockets will dominate military rocketry of the future. Solid propellant rockets also play a major part in scientific space exploration. *Two Grand Central solid propellant rockets are orbiting the earth right now!*

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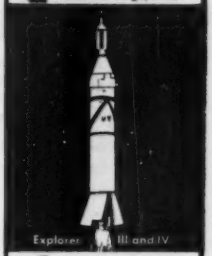
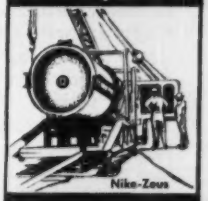

Explorer III and IV

Far Side

Vanguard


Nike-Zeus

Test Sled

DURING an early topographical survey, former RCAF pilot Carl Agar landed at a spot 6,500 ft. above sea level on a job for the B. C. Department of Lands.

1958, a test was carried out to determine whether it would be feasible to fly all supplies for construction of a small concrete dam. The dam, to be built for Greater Vancouver Water District, was located on a lake in a practically inaccessible area.

Only way into the area was by a foot path, the last part of which had a rise of 1,100 ft. in one quarter of a mile. Since the dam site was mostly rock, a test was made in which a complete diamond drill assembly was moved by helicopter up on to a mountain ridge on the west coast of Vancouver Island, indicating that such pieces of equipment could be flown in to the dam site.

Rock Heliport

The dam project started July 9, 1949. Work involved damming a gorge at the outlet of Palisades Lake, which would increase the water storage by approximately 2 million gallons. The site was approximately 3,000 ft. above sea level. To obtain level ground for a landing point, a patch of rock about 15 ft. square was blasted loose from a mountain side, then leveled. This "heliport" dropped away on three sides, with slopes from 45 to 90 deg., while on the fourth side, there was a high wall of broken rock.

All materials and personnel required in the dam construction were flown in and out by Okanagan with the helicopter. Materials all were weighed so that loads were properly balanced, since the aircraft had a carrier on each side. Equipment was stripped down to keep pieces at 200 lb., or less, and usually were comparatively easy to balance.

All told, approximately 400,000 lb. were lifted, taking more than 1,000 trips, each of approximately 12 to 15 min. duration including loading and unloading time. As many as 40 trips were made in one day.

Some of the materials which were flown in by the B-3 helicopter for this job back in 1948, included sand, gravel, cement, reinforcing steel, cement mixers, pumps, rock drills, rope, hose, cable, a donkey engine and skyline, complete cook house equipment, beds, blankets, stoves, heaters, nails, power saws, electric equipment, dynamite and caps, gasoline, fuel oil, aluminum sheeting, windows, doors, tents and tarpaulins, food supplies, various sundry articles, lumber, and a rowboat and outboard motor.

The single largest piece moved in was the bowl of one of the cement mixers which weighed 400 lb., and could not be carried on one side without upsetting the helicopter. The answer was to dig a hole, put the bowl down in the hole, and land the helicopter astride the hold, secure the cement mixer bowl, take off and fly it in. At the dam side, another hole had been dug so the bowl could be landed as it was taken off.

With its reputation established with successful completion of the Palisades Lake Dam, Okanagan continued its mountain flying through 1950, doing various types of work such as forest top dressing, timber cruising.

Plant Construction

However, in 1949, a new project which was to make Okanagan famous was begun. Here Okanagan played a significant part in the establishment of the Aluminum Co. of Canada's large aluminum refining plant at Kittimat on the Canadian Pacific coast. The plant needed a large quantity of electric power, and to secure this, a hydroelectric plant had to be constructed 60 mile inland at Kemano. Construction of this hydroelectric plant involved drilling a 10-mi. tunnel on a downward slant through a rock mountain, and erection of a transmission line from the hydroelectric plant itself to the smelter on the coast.

First part of the job consisted of scouting routes between Kemano and Kittimat. Fifteen possible routes were surveyed by the Okanagan B-3, and of these, one was chosen. Time was 20 flying hours, but it was estimated a

BUILDING a mountain camp for Aluminum Co. of Canada crews, Okanagan flew lumber into the mountains despite severe weather conditions. Note open cockpit.

ground party would have taken several years on foot to obtain the same data.

In addition, the helicopter was used in a very exacting triangulation survey which settled the route exactly for the 10-mi. tunnel, which not only transversed the mountain laterally but also vertically, descending quite a bit over the entire distance. This work was accomplished with Bell 47D-1 helicopters, of which the Aluminum Co. of Canada had purchased two for survey work in connection with the hydroelectric and aluminum plant project, and these were operated by Okanagan.

In 1952, Aluminum Co. of Canada bought two Sikorsky S-55s and two more Bell 47D-1s, which Okanagan operated for use in the Kemano-Kittimat project. During this project, the helicopter was an integral part of the operation, not serving as an emergency cure-all, but used to fill in the gaps where other forms of transportation either were too slow or unusable.

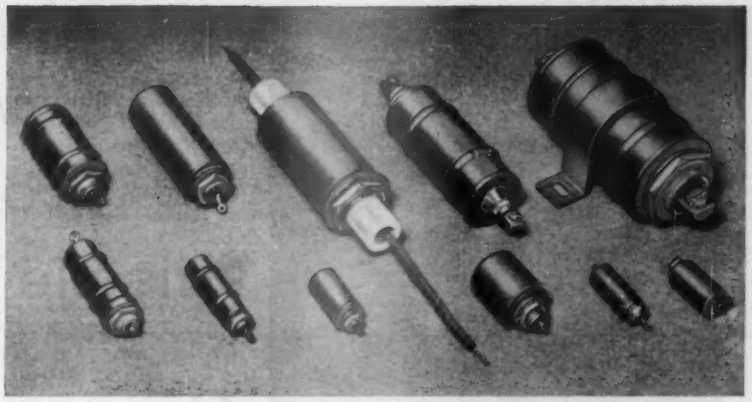
By the 1951 start of the Alcan project, Okanagan had bought a second Bell B-3, and also was operating the Alcan machines. For the next three years, the Alcan operation involved four Bell 47D-1s and two Sikorsky S-55 helicopters. These were used during the early part of the project for setting up the camps for the erection of the powerlines, including complete supply of parts and equipment needed in the early test operations. This involved such things as construction of a sample tower site at the 5,200 ft. level to measure ice accretion during the winter, to see if the line would be able to withstand the natural weather hazards.

Helicopter Activity

Probably the best summary of Okanagan's part in the Kemano-Kittimat project can be given by the statistics concerning the helicopter activity during the years 1951 to Dec. 1955. (Prior to 1951, the project involved, for Okanagan, the approximately 20 hr. of survey flights made by Carl Agar, noted earlier.) This work included:

- **24,430 trips,** 47,301 landings.
- **22,194 platform landings,** on platforms ranging from 8 ft. x 8 ft. to 16 x 16 ft.
- **25,521 passengers** carried.
- **280,530 lb.** of baggage hauled.
- **2,366,125 lb. of freight** hauled.
- **427,825 mi.** flown.
- **7,072 total project** hours flown.

In this effort, in addition to the types of material which had been carried in the Palisades Lake project, use of the S-55s made it possible to haul larger pieces of equipment since the S-55 payload ranged up to 1,500 and 1,800 lb. This enabled the helicopter to carry such things as larger donkey engines and air compressors, in addition to the standard loads of steel, tools, beds,



New Series of Sprague Cylindrical-Style Radio Interference Filters: top row, l. to r.—4JX14, 5JX94, 1JX115, 20JX15, 50JX20 bottom row—5JX27, 1JX54, 1JX113, 1JX117, 2JX49, 1JX118.

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The new cylindrical-style radio interference filters recently announced by Sprague Electric Company are the smallest and lightest filters of their type available for military and industrial electronic and electrical equipment. Their basic design was pioneered by Sprague in order to achieve maximum miniaturization.

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The natural shape of the rolled capacitor section and of the toroidal inductors dictates the cylindrical form. All filters have threaded-neck mountings for use on panels or bulkheads. This assures both the proper isolation between input and output terminals as well as a firm peripheral mounting with minimum impedance to ground.

Listed in Sprague Engineering Bulletin 8100 (available upon request to the Technical Literature Department) are 68 of the more popular low-pass filter designs intended for use as three-terminal networks connected in series with the circuits to be filtered. The excellent interference attenuation characteristics reflect the use of Thrupass® capacitor sections.

Since maximum effectiveness of filtering involves elimination of mutual coupling between input or noise source and output terminals, filters should be mounted where the leads being filtered pass through a shielded chassis or bulkhead. The threaded neck mounting is designed to give a firm metallic contact with the mounting surface over a closed path encircling the filtered line and to eliminate unwanted contact resistance so that the theoretical effectiveness of these units is realized in practice.

Typical insertion loss is determined by measurements made in conformance with Military Standard MIL-STD-220. Minimum curves for specific filters are available upon request.

For assistance in solving unusual interference, rating, or space problems, contact Interference Control Field Service Manager, Sprague Electric Co., at 12870 Panama Street, Los Angeles 66, California; 224 Leo Street, Dayton 4, Ohio; or 327 Marshall Street, North Adams, Massachusetts.

Photo courtesy Boeing Airplane Co.

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SECOND GENERATION VEHICLES are introducing extremely sophisticated requirements for shock and vibration protection. Utilizing experience gained on *Atlas, Titan, Hawk, Jupiter, Talos and Bomarc*, LORD is now developing high-performance mounting systems for such advanced projects as *Minuteman* and *Mercury*. Selection of LORD to custom design, test and manufacture mounting systems for these projects reflects LORD's outstanding capabilities for *reliability protection.*

LORD CAPABILITIES have been utilized on many successful projects involving all types of mounting systems: center-of-gravity, rectilinear, focalized, high-returnability, active, integrated. Rigorous specifications have included protection against in-flight, storage and transport environments, broad temperature conditions from −65° to + 500°F, "white noise", 100G shock loads, broad frequency spectrums, 25G superimposed sustained accelerations, random excitations and rotational inputs.

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stoves, heaters and other material.

Following the work in the Alcan project and its attendant expansion for Okanagan between 1951 and 1953, the next operation which marked a milestone for the company began in 1956 when the firm received a contract on the Mid-Canada Radar Defense Line.

At this time, the Royal Canadian Air Force gave Okanagan 14 Sikorsky S-55 helicopters to operate. These are still working to maintain and supply parts of this line from five main bases with three aircraft and two crews per base. This operation continues year-around.

Average time involved is 60 hr. per aircraft per month, while the pilots average 80 to 90 hr. per month each. Primarily, this operation is conducted in cold weather. In addition, during the 1950 to 1956 period, the company began getting deeper into oil and mineral survey work, setting up camps and supplying them for various mining companies and oil firms involved in geological surveys. For this, Bell helicopters were primarily used.

Pipeline Patrol

Another project in which Okanagan became involved in the early 1950s was the Trans Mountain oil pipeline between Edmonton and Vancouver, a distance of 712 mi. Okanagan had a small part in building some parts of the pipeline and, in addition, contracted to patrol the entire line every 10 days.

Within two years on this operation, the statistics looked like this—total number of patrols, 355; total hours flown, 1,234 hr. 55 min.; days flown, 380; takeoffs and landings, 1,415; mi. of pipeline patrolled, 80,511; reports made, 163. Results included four leaks observed and reported, 30 washouts observed and reported, five exposed major sections reported, seven slide areas reported.

In 1954 Okanagan expanded its operation and established a base at St. Johns, Newfoundland, which was operated under the name of United Helicopters, Ltd. The following year, 1955, two existing companies were purchased outright. These were Canadian Helicopters, Ltd., of Toronto, together with bases at Toronto Island Airport, Ft. William and Gander, Newfoundland, and Smart Aviation, Ltd., of Toronto, the latter a fixed base operation.

During 1955, Okanagan carried out a timber cruising project which took a period of four months, covered 1,750,000 acres and used 498 hr. of flying time. Estimates were that without the helicopter, the cruise would have taken approximately five years to accomplish the same project.

From June to September, 1955, Okanagan performed its next pioneering major operation. This was called "Operation Franklin." It involved two Sikorsky S-55 helicopters, eight Okanagan personnel, and 14 Canadian government representatives.

The effort consisted of a broad regional reconnaissance geological survey with emphasis on the determination of major stratographic units and structures. Mapping of the regional distribution of these features was made concurrently with local study. The work was carried out on arctic islands in the district of Franklin in Canada's North West Territories; on the major part of the Queen Elizabeth Islands, plus the northern part of Summerset and Prince of Wales Islands, and the northwest tip of Baffin Island.

Work was conducted from five main bases. The bases were related to the number of fuel caches which had been established by the RCAF in the far North West Territories. Helicopters were partially dismantled and flown to Resolute Bay in an RCAF Fairchild C-119, where they were both reassembled and tested prior to jumping off for the first survey base.

All elements of these survey flights were critical. All preflight planning details were worked out very closely in advance.

Each of the parties consisted of geologist and an assistant, plus the pilot. Food and equipment for 14 days were

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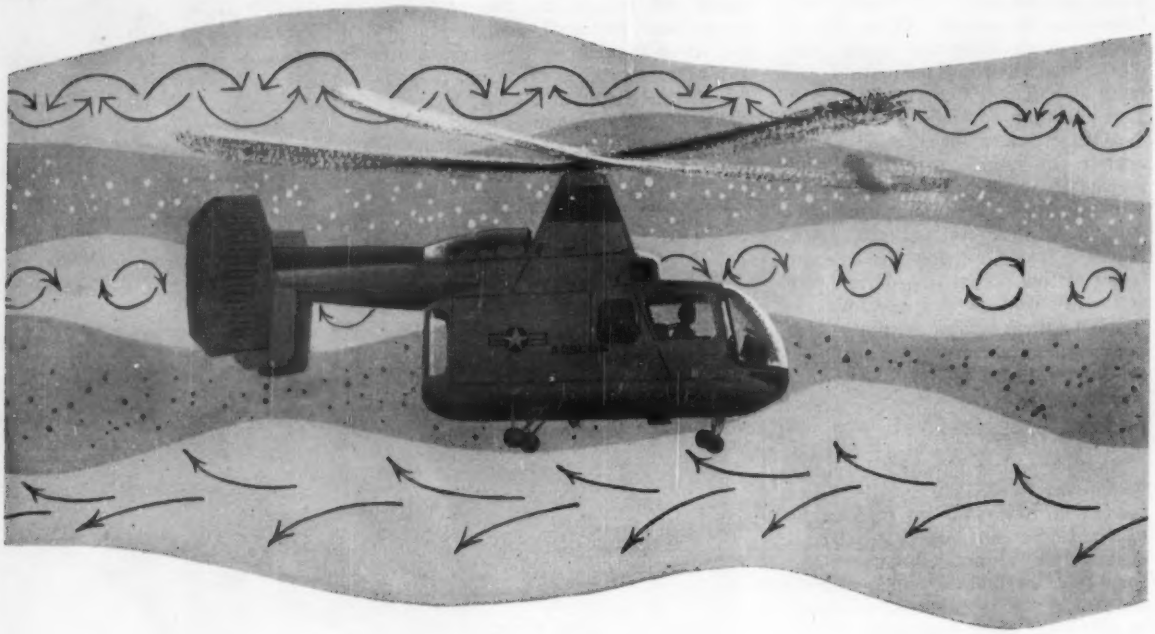

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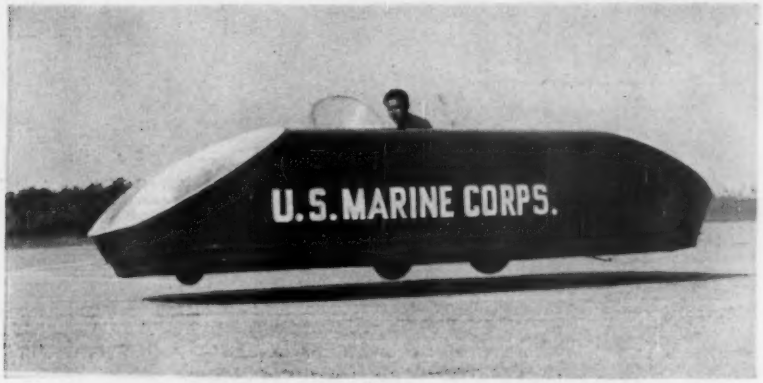
carried. Weight of the complete party averaged approximately 700 lb. Length of stay in one location averaged four to five days. On every flight, one of the geologists would act as navigator up front with the pilot. Aeronautical charts scaled at 8 mi. to the inch and air photographs were used for navigation. In addition, the geologist navigating also mapped geological features on every flight. No deviations from the flight plans were made during flight without notifying base operations.

Indicative of just how critical flight planning was, fuel consumption for both machines was worked out to approximately 3.6 lb. per min., and an over-all cruising speed of 70 mph. One hour reserve fuel was always carried and a gross weight of 7,200 lb. was used in both machines. General meteorological forecasts were made for 24 hr. periods and found valid; however, local conditions often prevailed en route which were not able to be forecast.

Much of the navigation was over packed ice, and had to be done by directional gyro and dead reckoning and estimated drift. Flying along unbroken snow conditions and packed ice were hazardous where the areas were featureless. The danger of "white-out" was always present.

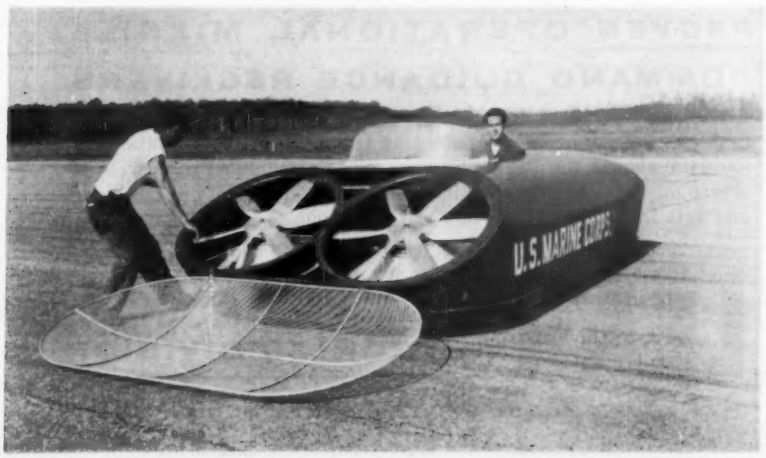
When the parties moved from base to base, where the average distance between bases was 110 mi., except one, which was a 200 mi. jump, the helicopters were fairly limited by the distance to be traveled, in the amount of extra fuel and weight they could carry. However, despite weather hazards, all base changes were accomplished without major mishap.

During the operation, one helicopter flew 292 hr., 45 min., and the other, 263 hr., 40 min. Areas explored and mapped were very far from civilization, extremely raw land, but well suited to



Marines Evaluate Ground Cushion Vehicle

Ground cushion vehicle for U. S. Army and U. S. Marine Corps is being developed by National Research Associates, College Park, Md., and is designated GEM-1 (Ground Effects Machine). Marines now are evaluating the GEM-1 shown here. Army designation is FASS (Free Air Suspension System). Vehicle is constructed of an aluminum alloy, although body shell and internal air ducts are composed of glass fiber. Control stick actuates a 10 in. slot around the vehicle to provide forward, backward and sideward movement; power is from two 40 hp. Triumph piston engines, one fore and one aft, each driving two shrouded six-bladed 42 in. diameter propeller fan. GEM-1 operates at 9-15 in. altitude; design speed is 38-58 mph. Vehicle is 14 ft. 7 in. long.



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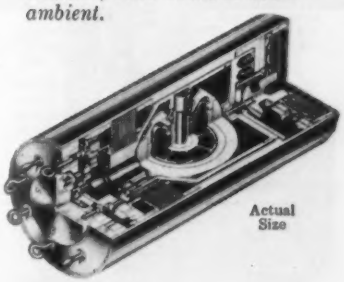

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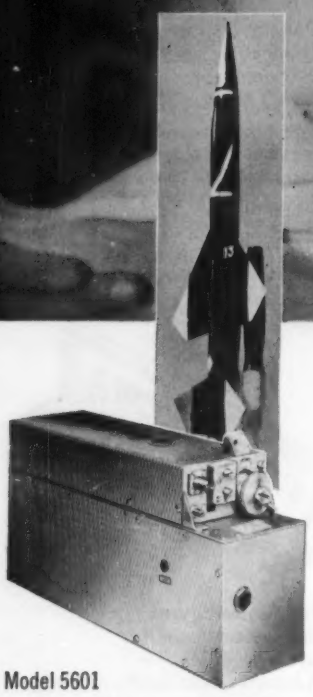

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Lightplane Licensed for Flying in Japan

David Hickler, Japanese regional manager for Civil Air Transport, is shown at Haneda International Airport with his Cessna 172, first plane licensed in Japan for operations by a private owner. All other lightplanes in Japan are operated by business firms. Cessa 172 was shipped to Tokyo by boat from Los Angeles, Calif.

helicopter operations in that, at least no high temperatures were encountered. On the adverse side however, the problem of visibility, snow, and local weather phenomenon such as fogs or open patches of water, made the operation less than optimum.

Okanagan bought its first Sikorsky S-58 for work on the Mid-Canada Radar Defense Line. One of the reasons was that part of the contract involved hauling generators which weighed approximately 3,000 lb., well beyond the capability of the Group's Sikorsky S-55 machines.

Since then, in addition to the Palmdale powerline, Okanagan has found a number of jobs for this machine. Faith that even more will be coming along is shown in the purchase of the two additional S-58s.

One job for which the S-58 was used was on the St. Lawrence Seaway, where it was used to help accurately measure the depth of the river at the Lachine Rapids. Here, boats were ineffective and helicopters had to be used.

The operation called for the S-58 to hover at a specific altitude. A 500 ft. weighted cable was dropped to the bottom of the rapids, and a triangulation was made from the shore on each side to the helicopter to accurately ascertain the depth of the rapids in this area.

Over the years, Okanagan has learned a number of operational techniques which have contributed to the company's success. Also, the company has developed, in certain areas, special equipment suited to the helicopter and its mission, although for many jobs ordinary non-optimized equipment has been used.

An example of their learning can be seen in the Palmdale powerline job for Southern California Edison. Here, Okanagan had learned to fly the S-58 at less than maximum gross weights. This actually wound up being more efficient in the long run, in that less than maximum loads are easier to handle on the ground, in flight and load and unload. Therefore, during an overall period of hours, the greater efficiency made it possible to fly more trips than if maximum gross weight had been used each time. Consequently, for any given sum of hours, the total amount of freight moved was greater than it would have been had maximum gross weight been used on each flight.

In addition to moving a greater total of tonnage of material in a given number of flying hours, the lower gross weight operation increased safety and lessened strain on pilots as well as on the machine. This cut the over-all cost since there was less wear and tear and maintenance time necessary on the helicopter, and also the utilization rate was increased.

While average loads weighed in the area of 3,000 to 3,200 lb., at times the S-58 carried up to 3,600 to 3,700 lb.

On the Palmdale job, turbulence in the hills and the high desert temperatures also combined to make it impossible to operate at maximum gross weight constantly, another factor in the operation.

Okanagan emphasized that it is a very few hundred pounds at the high end of the gross weight scale which can make the critical difference in the operation. Still, the average payload carried was over 3,000 lb., considerably higher than any other machine could haul.

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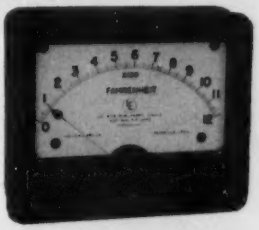
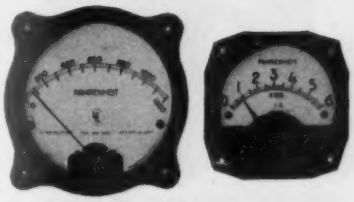


MODEL 58PY, above, has been used extensively by leading motor car manufacturers for road testing on the "Proving Grounds" — where performance counts. Housed in rectangular bakelite case, has 6" hand drawn scale and is fully compensated for ambient temperature. Made in ranges listed below, with suitable thermocouple materials.



MODEL 23B, left above, has same type movement as our aircraft pyrometers. Housed in flanged, 4" round, bakelite case for panel mounting.

MODEL 20B, right above, has same 3" steel case and same movement as our aircraft panel indicators. Both are fully cold-end compensated and available in standard ranges listed, with suitable thermocouple materials.

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The only completely transistorized marker beacon receiver TSO'd in Category A. Fail safe light circuit. Simultaneous aural and 3-light visual indication. Receiver weight: 3.5 pounds. Single shock mounting, M-41A adds 1.4 pounds. Use of multiple unit shock mounting reduces overall weight. Input power 0.350 amps at 27.5 volts dc, 0.325 at 13.75 volts dc. High altitude and low altitude sensitivity settings may be selected by pilot.

The R-31A and R-33A Receivers, shown with the T-25A ARC's 360 Channel VHF Transmitter, in the M-43A, one of ARC's new multiple shock mounts. Compact mount offers simplified installation plus reduced space and weight.

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Alouettes Fly Coast-to-Coast in 36 Hr.

Two Republic turbine-powered Alouette II helicopters, shown being delivered by Bill Littleford (left), Republic's Helicopter Division general manager, to Fred Lemke, Coast Rotors, Inc., flight operations director, flew from Republic's Long Island plant to San Diego in about 36 flying hours. Trip was made in 16 hops; from Tulsa, Okla., on, headwinds were about 40 kt., becoming 60-80 kt. in mountain country, according to Lemke. Coast Rotors will operate the Alouettes for interplane travel and other uses (AW Nov. 2, p. 27); company has four or more on order.

had to be brought to the hover at the destination site in addition to being hooked on initially at the hover. Where the helicopter is able to have a slight roll at takeoff and landing, higher gross weights can be handled. Where the hover is used, lower weights are carried.

On the Edison job, Okanagan's S-58 carried one-half cubic yard of concrete plus a 500 lb. steel bucket, per flight. The helicopter could have carried an appreciably heavier load of concrete per flight, with the proper container. However, the bucket was the same heavy steel one used in earlier Southern Cal Edison cement pouring experiments.

Following pouring of the concrete, Okanagan S-58 was used to carry in and raise the gin pole at each tower site to an attitude of approximately 70 or 80 deg.

It was much easier than doing it by hand, after the gin pole had been carried in by helicopter in two parts. It required approximately 3-4 min. to raise the pole.

All helicopter operations require a team, primarily the pilot and ground man, in combination with the crewman who rides in the lower cargo compartment of the helicopter, called the belly man. Here, Okanagan has frequently trained the client's personnel to the required skills for ground work at the load site. However, at the drop site, an air crewman is required, usually an Okanagan pilot.

Load Release

At the drop site, the belly man directed the pilot to the proper spot to release the load. This was because at some sites, located on ridges or mountain tops, the man on the ground was completely invisible to the pilot during the hover while the load was released. Consequently, accuracy in placing of the load was dependent on the man

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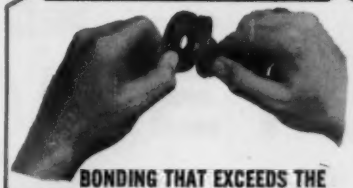

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A.I.D. and other combined guidance and integrated systems now under development at GPL are particularly significant because they utilize *existing* systems and elements, *existing* components of proven reliability and accuracy, *existing* techniques for manufacture and maintenance. Yet continuing study of progress in the state of the art and continuing study of new system concepts keep these systems as advanced as the aircraft and missiles they will guide.

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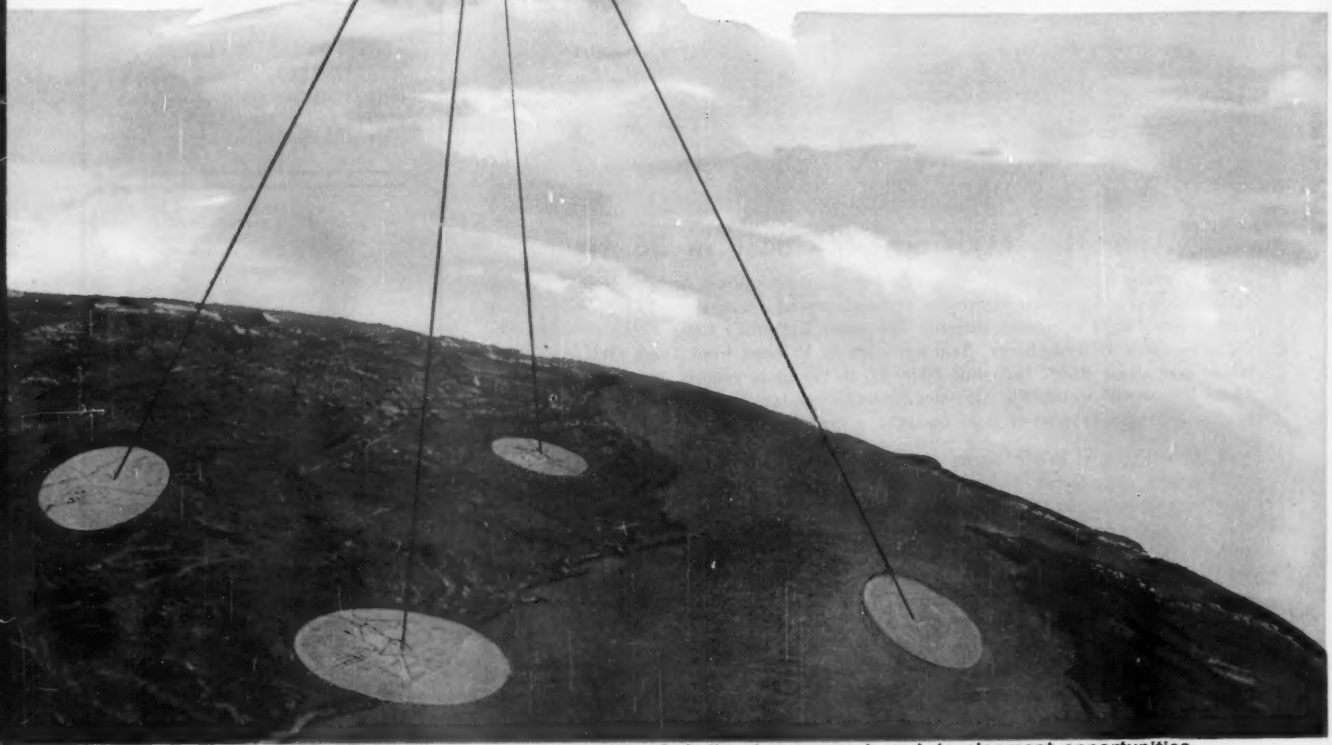

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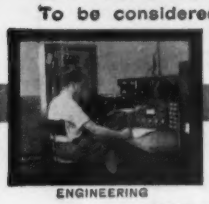

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down in the cargo compartment. Lack of close terrain for pilot visual reference in hover also made the job harder.

On this type of approach, where the drop site man became visible, pilots made their approaches in a sideways attitude rather than head on, since this way the pilot is able to keep the site and people in view longer than he can should he approach head on.

Another problem which has developed on occasion during Okanagan operations, especially with the S-58, is the raising of dust at either drop or loading site. Here, experienced men on the ground are vital.

Problems such as dust, sand and gravel being thrown into the air by the helicopter's downwash, has pointed out another important operational aspect to Okanagan. This is proper site selection for freight pickup and drop locations.

Site Choices

Involved here are such things as the approach and departure flight paths, the ground itself, whether it has grass, or some other cover which prevents dust and sand blowing up during the operation.

Choice of a bad site increases costs, Okanagan has found, as well as increasing the danger to the machine and personnel involved.

This has indicated that helicopters are best used during any operation when a helicopter pilot and operations man are brought into the planning of the operation early—if possible, from the very beginning. In this way, the use of the helicopter can be tailored to the job, with optimum sites, flight paths, load planning, etc. figured ahead, by those who know the helicopter's characteristics and limitations. Knowing all the idiosyncracies of the helicopter enables the pilot and operations man to tailor the customer's effort insofar as is possible to the unique capabilities of the machine, thereby doing the best job for him at the lowest cost.

Experience also has shown Okanagan, as well as other helicopter operators, that usually two types of machines are needed on most any job. One is the big, weight-lifting Sikorsky type and the other is the smaller Bell type, for movement of personnel and light supplies. The Bell serves as a runabout, capable of carrying people to the site, parking there while the main loading and unloading is done, and its pilot serves as the drop site ground man, then flying on to the next site. For the Edison operation, the Bell helicopters were supplied by a U.S. operator.

Not only did the Bell machines carry the personnel and light loads, they also served to carry the lead line, a small diameter aircraft type cable over the powerline. After the small lead line is

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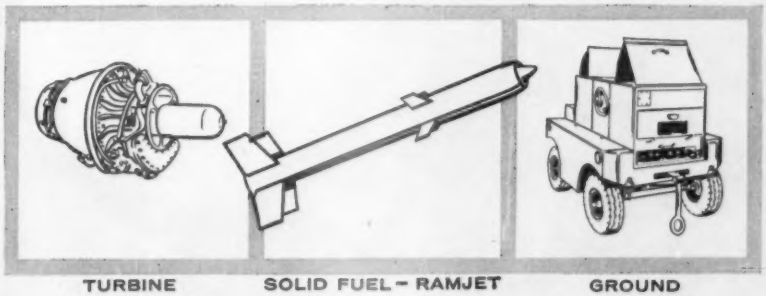

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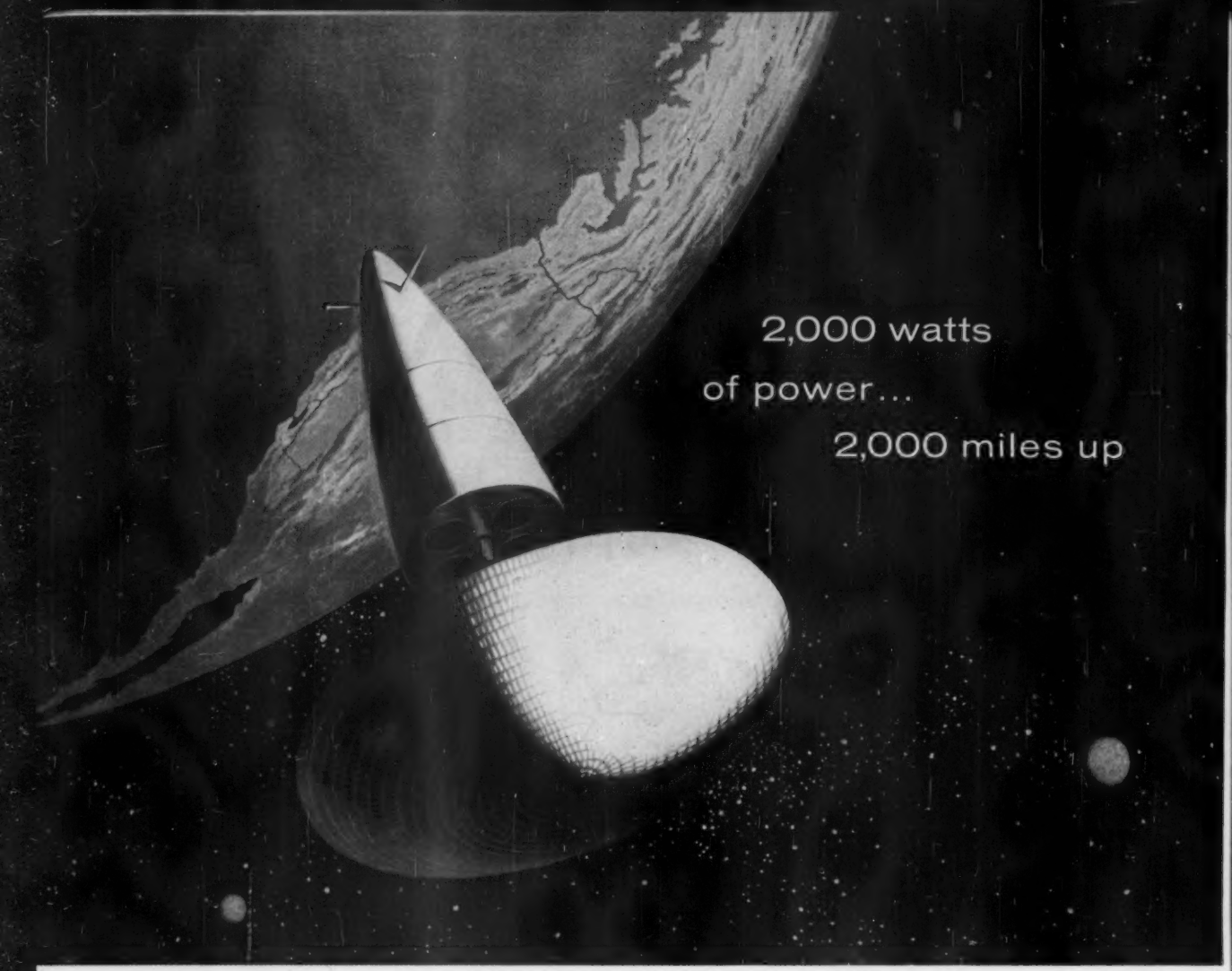

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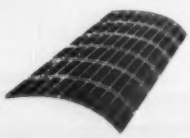

Typical solar energy converter. A panel of solar cells of approximately 20 square yards can produce 2,000 watts of electricity.

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Solar energy converters, capable of delivering 2,000 watts or more, are now feasible as power sources for inaccessible and remote places.

Hoffman silicon solar cells, used in these converters, are the most practical and efficient means yet developed for converting solar energy into electricity. Already proved in the U. S. Navy's *Vanguard* satellite, Hoffman solar cells will continue to power its radio transmitter as long as it orbits the earth.

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For more information, write Dept. 11, Hoffman Laboratories.

Silicon solar cells—by Hoffman—the key to today's and tomorrow's problem of power in outer space.

installed, larger cables are pulled across by it in increasing sizes, until finally the main electrical current carrier itself, is pulled into place by winch.

Eventually, Okanagan feels, it may be possible to string the main current carrier by helicopter. However, since currently the large carrier cable drums weigh on the order of 6,800 lb., it will be required that a machine such as the proposed Sikorsky S-60 "flying crane" is used for its load carrying capabilities, its multi-engine and single rotor configuration, plus the capability of the pilot being able to watch his load through the backward and downward looking control station, while a safety pilot is able to remain in the conventional forward position.

F. B. Ayer to Lease Converted Convairs

New York—Pressurized Convair 240 executive transports will be leased to corporations at a rate of $10,000 per month, under a new plan developed by Frederick B. Ayer & Associates.

Plan will be modified to the corporation's specifications—at a cost of between $100,000 and $200,000. Ayer said when the sum of the monthly payments equals conversion costs, the corporation can continue the lease arrangement at a reduced rate, or return the plane to Ayer. Corporation also can purchase the plane during the lease term, with one-half of the total payments made at the time of purchase deducted from the total sales price.

Ayer sells the 240 for $200,000 in 40-passenger airline configuration, or $335,000 if refitted in executive configuration.

Lease payments start on delivery of the airplane to the corporation.

U. S. Business & Utility Aircraft Shipments*

September, 1959

Manufacturer & Model	No. of Units	Net Billings
Aero Design 500	2	$886,000
560E	2	
680E	5	
720	1	
Beech 18S	8	$2,835,000
Bonanza	42	
Mentor	—	
Twin Bonanza	4	
95 Travel Air	12	
Call Air Model A5	—	———
Model A8	—	
Cessna L19	—	$2,478,000
150	39	
172	18	
175	24	
180	16	
182	36	
310B, C	22	
Champion Model 7EC	1	$132,000
Model 7FC	4	
Model 7GC	13	
Model 7HC	4	
Colonial Skimmer IV	N.R.	N.R.
Mooney Mark 20	14	$172,000
Piper Super Cub	26	$1,452,000
Tri Pacer	28	
Apache	11	
Comanche	46	
Pawnee	7	
Totals	385	$7,925,000

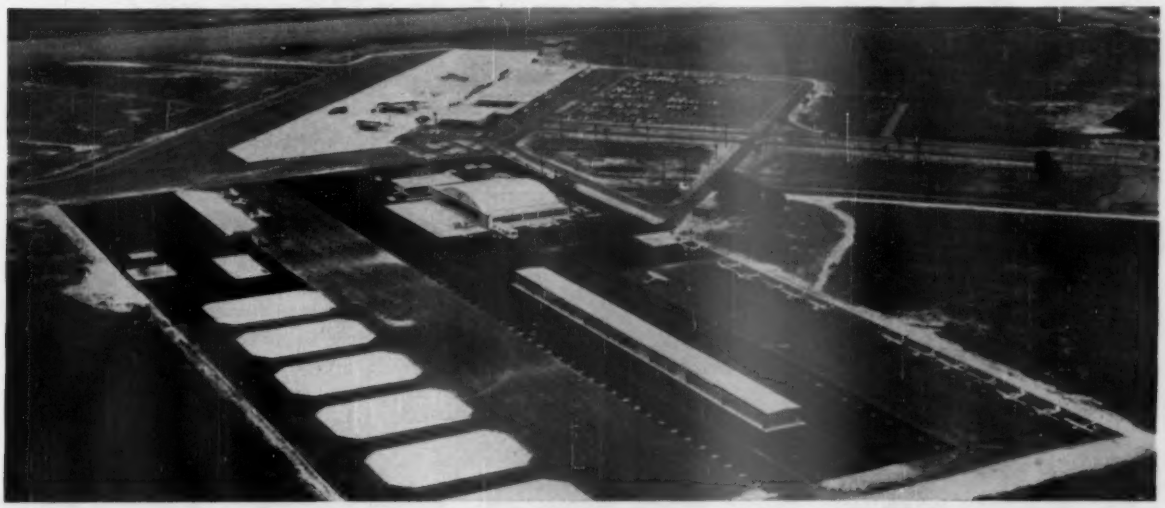
*—Compiled by Aerospace Industries Assn.'s Utility Aircraft Council.
N.R.—Not Reported.

Light Helicopter Use Rises in South America

Dallas, Tex.—Number of light helicopters operating in South America will about double in the next four years, according to a service representative of Bell Helicopter Corp. who recently returned here after a stay of a little more than four years south of the border.

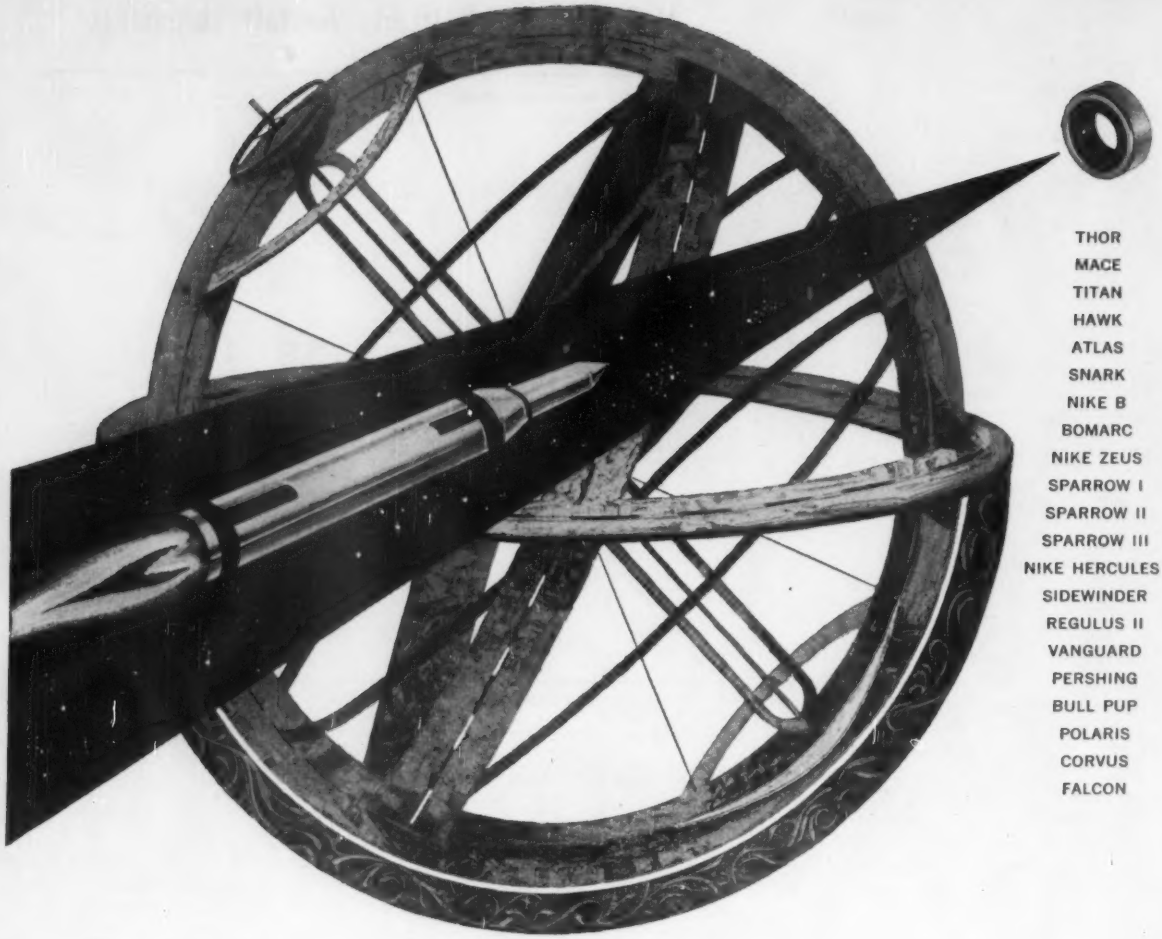
During his stay in South America, the number of Bell rotary wing aircraft operating there grew from 79 to 153, both civil and military types, service representative Sil de Yoreo reports, and he sees a similar growth in the same period ahead. He believes that few new operations will start; the increase in sales will be mainly to already established users.

De Yoreo thinks that Brazil shows the greatest potential for helicopters because of the large industrial and development programs just getting started in that country.



Sunny South Aircraft Service Opens New Facility

Large hangar and administration building are main structures at new Sunny South Aircraft Service area at Fort Lauderdale, Fla. (AW Oct. 5, p. 65). Facility cost $325,000 and includes 15 T-hangars. Sunny South, Cessna dealer, says its 1959 gross will be over $3 million.



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ND Adds New Dimensions To High Speed Gyro Rotor Bearings!

At speeds up to 24,000 RPM precision rotor bearings in inertial guidance and navigational systems are highly critical components. Early research and development in design and manufacturing at New Departure is solving the problem and thus winning vital roles for N.D. integral rotor bearings in missile projects. For example, "B" Series bearings with separable inner ring developed by N.D. are helping set performance records in such inertial guidance systems as the AChiever.

New Departure is also supplying high-precision rotor bearings for the inertial guidance system in Polaris.

These bearings, through advanced manufacturing techniques, exacting inspections and controlled environmental tests, backed by 50 years of laboratory testing experience, give precision and uniformity far above the most precise industry standards. They promise new performance and *reliability* for the submarine-launched IRBM.

You can look to improved *performance* and *reliability* when you include an N.D. Miniature/Instrument Bearing *Specialist* in early design level discussions. Call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.

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proved reliability you can build around

Bell 47G-3 Shows Altitude Capabilities

By Erwin J. Bulban

Ft. Worth, Tex.—Combination of a new Franklin supercharged engine and rotor system from the Model 47-J four-place helicopter gives the new Bell 47G-3 utility helicopter an ability to carry its design maximum gross weight to high altitudes with a sufficient power reserve providing high margin of safety.

In demonstrations of a prototype 47G-3 at Pikes Peak, Colo., the new rotary wing aircraft showed it could lift a load equivalent to its own empty weight—1,539 lb.—from this 14,100-ft. elevation. During the test, the density altitude at Pikes Peak actually was 15,400 ft. and the aircraft made landings earlier at a 17,500-ft. density altitude.

Tests also demonstrated that the 47G-3's supercharged 6VS-335 engine will maintain necessary power to hover the aircraft at a maximum gross weight of 2,550 lb. at altitudes in excess of 16,000 ft. The engine actually is certified to deliver 225 hp. at 3,100 rpm. to 10,000 ft. The 47G-3 trial showed that this rating is extremely conservative, since it apparently maintains power at some 6,000 ft. or more higher altitude.

Autorotation Shown

Demonstrator pilot Al Averill capped the trials by making an autorotational landing on Pikes Peak, flying solo, with the aircraft at approximately 2,200 lb. gross weight, cutting power during the final approach at about 100 ft. altitude while in a 90-deg. turn.

Extra margin of power, together with low disk loading provided by the larger rotor, should take the strain off pilots operating the new helicopter even at gross weight at high altitude. The 37-ft. diameter rotor of the 47G-3 provides a disk loading of 2.37 lb./sq./ft., compared with the 2.55 psf. for the 47G-2. It is such that at 8,000 ft., a flareout for autorotation would just about stop the rate of descent and after this maneuver, there would still be ample collective pitch available for a normal landing, Averill explained.

LONGER tail boom (14 in. extension) is visible in this flight view of the Bell Model 47G-3 helicopter hovering over 14,110-ft. Pikes Peak, Colo. Splice, which compensates for the larger rotor, is the dark-painted tubing between the fuselage center fram and the white-painted tail boom.

Bell Model 47G-3

Empty weight	1,539 lb.
Useful load	1,011 lb.
Gross weight	2,550 lb.
Payload	500 lb.-plus
Service ceiling	23,000 ft.-plus
Hovering ceiling (in ground effect)	18,500 ft.-plus
Hovering ceiling (out of ground effect)	14,500 ft.-plus
Maximum cruise speed (sea level)	105 mph.
True airspeed (15,000 ft.)	110 mph.
Maximum range	236 mi.
Maximum endurance	3 hr.-plus
Fuel capacity (100 octane)*	41 gal.
Rate of climb (15,000 ft.)	700 fpm.

* Specified by aircooled motors (Franklin) and used in Pikes Peak program. Franklin is checking performance of 6VS-335 engine using 80 octane, for possible use in emergencies.

Carburetor Heat

He also noted that all through the test program on the 47G-3 thus far, he has never found it necessary to use carburetor heat, indicating that the supercharged engine possess favorable anticing characteristics.

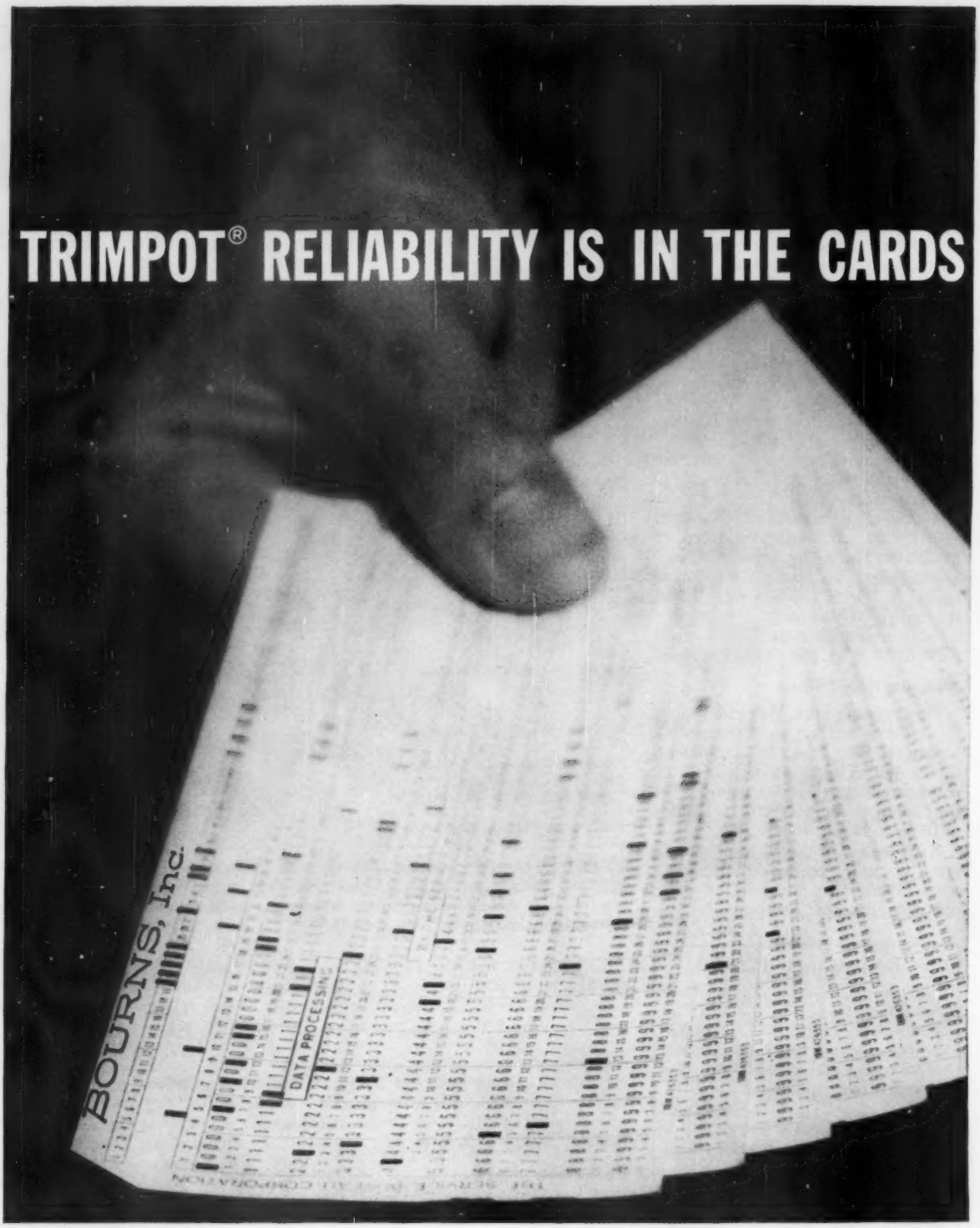
Early results of the test program were so favorable that when Bell decided to try the aircraft at Pikes Peak it invited nearly a dozen helicopter operators to witness the trials and fly the machine. Several made flights with useful loads exceeding 1,000 lb. and several climbed over 17,000 ft., landed on Pikes Peak.

One operator said that he believed that with the reserve power available, the aircraft could carry and land a 1,000-lb useful load at 20,000 ft. altitudes. A Bell test pilot said that he doesn't know what the actual ceiling of the aircraft is, but he believes it probably can exceed 30,000 ft. At Ft. Worth, Tex., prior to the Colorado program, the prototype reached more than 21,000 ft. density altitude with power to spare. Outside air temperature was approximately 17-18F.

Certification Tests

Bell now is undergoing a Federal Aviation Agency certification program and expects to have the first production 47G-3 available for delivery next March. Since the aircraft was developed entirely

TRIMPOT® RELIABILITY IS IN THE CARDS



Test information punched in these cards can provide detailed performance reliability statistics on Trimpot production. The cards summarize extensive environmental tests which Bourns regularly conducts above and beyond regular quality control. In Bourns' own Reliability Assurance Laboratory, monthly samples are taken at random from factory stocks and completely tested for conformance to all environmental and electrical specifications on Trimpot catalog sheets. Results can then be fed into IBM computers which analyze performance data with corrective action taken immediately, if required!

This program is the only one of its kind in the industry. Only Trimpot potentiometers are tested so thoroughly, so frequently. In short, Trimpot reliability is a fact—one you can put in your next circuit.

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Trimpot reliability starts at the beginning. Here an incoming lot of potentiometer leadscrews undergoes a dimensional check.

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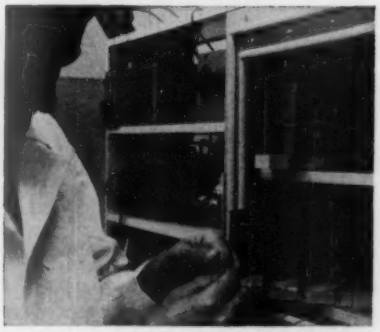
100% final inspection is made possible by this exclusive high-speed system developed by Bourns to test all major electrical characteristics. Critical dimensions of each unit are also checked.

And Reliability Assurance Tests Like These...

This vibrator for measuring conformance to Mil-Specs is an important part of the extensive equipment in Bourns Reliability Assurance Laboratory.

This chamber subjects potentiometers to standard military tests for humidity, provides important feedback on product performance.



1000-hour load life testing per Mil-R-19A takes place in ovens like this, which hold temperatures at desired levels at full rated power.

When tests are completed and the results tabulated, Bourns engineers plot frequency distribution curves from the steady flow of test results. Analysis of these curves and other data from testing provides a continuing check on all models to see that they meet the most exacting standards of performance. This analysis and the constant flow of information between the Testing and Production departments is your assurance that the Trimpot potentiometers you specify and purchase will meet specifications.

Write for the new 8-page folder describing the Bourns Reliability Assurance Program and a copy of the Trimpot Summary Brochure.

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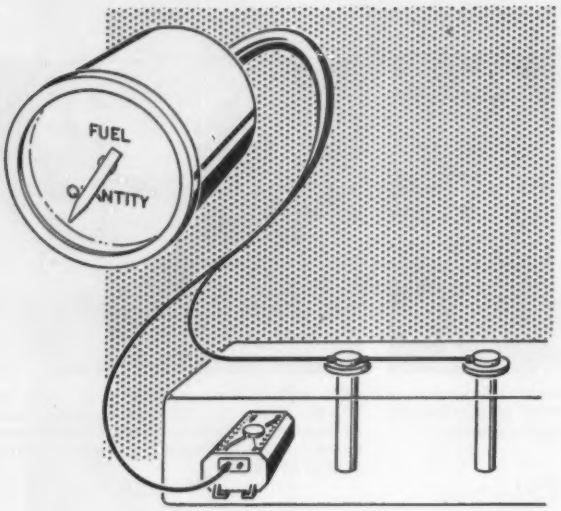

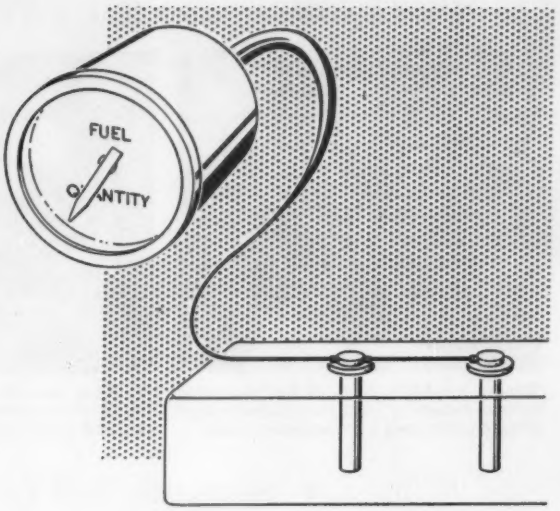

Liquidometer True Weight Gaging Systems sense the dielectric and density of aviation fuel as two independent variables. Volume is measured by tank units and a reference condenser, density by a LIQUIDensitometer*. Controlled by these measurement signals, the Liquidometer system provides the pilot with a direct indication of the *true weight* of fuel remaining.

Conventional gaging systems, on the other hand, depend upon the unpredictable relationship between the dielectric and the density of fuel. This relationship varies widely among different batches of the same fuel and, when plotted, appears as a cloud of points rather than a single precise line. Thus, conventional systems, incapable of measuring density directly, can only *approximate* the weight of fuel remaining.

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with company funds, it would be available immediately for the civilian market.

Company officials declined to set a firm price on the new model, but indications are at the present moment it will probably be under $46,000, or less than $5,000 under the price of the 1960 Model 47G-2, which the company is continuing in production.

Basic configuration is very similar to the 47G-2 model, but the 47G-3 will have a tail boom 14 in. longer than the earlier model to accommodate the increased rotor diameter. Model 47G-2 rotor diameter is 35 ft. Many of the 47G-2 parts will be interchangeable with the new model. The new aircraft also will have the Model 47J's tail rotor blades, but so will the 1960 Model 47G-2. Indications are that some operators with later Model 47G-2s could have their aircraft converted to 47G-3 configuration, although at this time Bell says that nothing has been worked out on such a modernization program.

Texans Plan Airport For Executive Planes

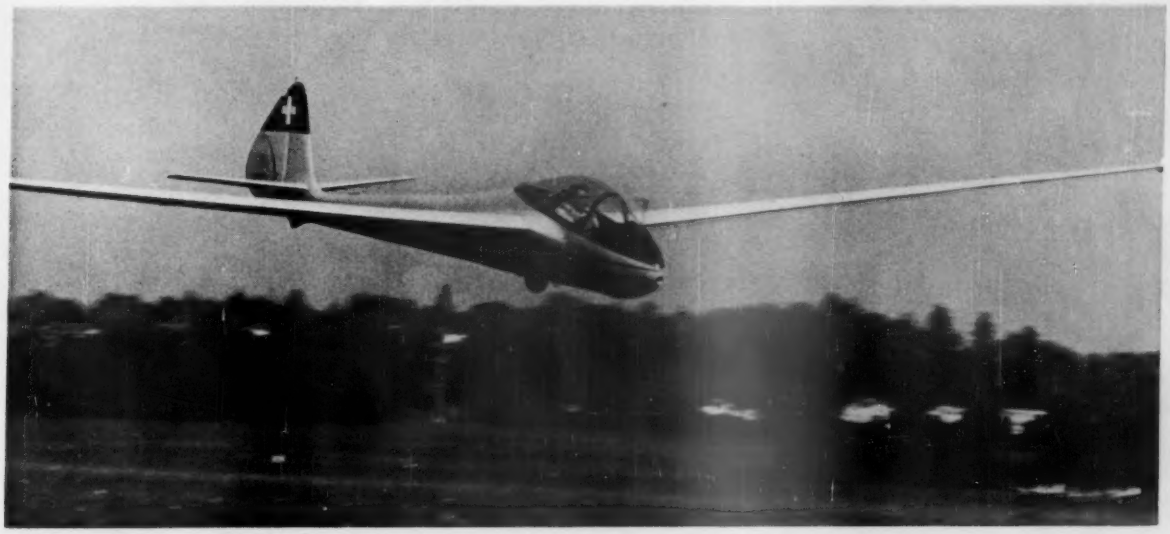
Dallas, Tex.—Multi-million dollar executive aircraft airport and industrial center is being planned for the Dallas-Ft. Worth area with completion of Phase 1 scheduled by next summer.

Master plan's first phase envisages elaborate business plane facilities on a 760-acre site south of Ft. Worth, with a 6,000-ft. runway, two 5,000-ft. runways, a dozen large hangars and 24 smaller hangars. An airport terminal building with 52,000 sq. ft. of space also is planned.

Among early units will be erection of a 125-unit motel.

Corporation which will handle development of the installation is Sphere, Inc., composed of a group of Texas businessmen. Sphere, Inc., says that the new facility also will be the home of a new research and development organization being formed by the corporation, which will specialize in missile, space and electronic work.

A plane manufacturing plant—which would initially produce a two-place light aircraft—also is being considered in the master plan. Completion of the final phase of the facility, including laboratories and the aircraft factory, would be in late 1962, according to Sphere, Inc., spokesmen.



Swiss Pilot Demonstrates Polish Jaskolka Sailplane

Polish SZD-8bis Jaskolka sailplane, shown here in Swiss markings and flown by Swiss pilot E. Wick, is a high performance design of all-wood construction. Wick demonstrated aerobatic and high speed capabilities of the aircraft at a display marking the 50th anniversary of the Geneva, Switzerland, Flying Club at Cointrin Airport. Towed to about 2,000 ft. by a Dewoitine D.26 vintage Swiss and French high wing parasol fighter plane (below), Wick entered an aerobatic routine climaxed by a low altitude pass (above). Jaskolka (swallow in Polish) holds several world records for speed and distance. Wing span is 52 ft. 6 in. and normal gross weight is about 750 lb. Best glide ratio is better than 25:1 and minimum sinking speed is about 2.5 ft. per second.

In the event of attack... we cannot expect more than minutes warning and minutes to retaliate. Heretofore ... inertial systems in air-launched missiles required as much as thirty minutes warm up time before operation and an additional amount of time before achieving specified accuracy. The new G.E. Platform is designed specifically to give satisfactory performance over a wide range of temperatures in high G environments.

It is smaller in size and weight than similar platforms and the following features are indicative of the performance to be expected:

1. Fully operable within one minute after power is applied.
2. 20 minutes after –55°C start–it achieves accuracy as specified.
3. Ambient temperature –65°C to + 100°C.
4. Tolerates high acceleration environment.
5. Platform and associated electronics total only 55.7 pounds.

This lightweight ruggedized environmentally suited platform is ideal for long range air launched missiles. The unusually low drift rate eliminates the necessity of "trimming" or adjusting the gyro before each mission.

More complete details are available on the system by contacting Manager–Control Sales, General Electric Company, Light Military Electronics Department, Armament and Control Section, Johnson City, N. Y., Dept. 12F.

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Soviets Favor Czech Morava as Ambulance

Brno, Czechoslovakia—Soviet Russia has found the Czechoslovakian Morava touring or ambulance aircraft superior to the Antonov An-14 Bee, according to Omnipol, the foreign trade corporation in charge of export trade of Czech aircraft and associated products.

The L200 Morava A, latest version of the L200 Morava touring or ambulance aircraft built by the National Aircraft Works, Kunovice, Czechoslovakia, was shown at the recent trade fair here (AW Oct. 19, p. 90).

First model of the Morava flew for the first time in April, 1957, and the Czech airline Ceskoslovenske Aerolinie has been using increasing numbers of this type for the last two years for air taxi duty.

Russia, which bought and tested a few L200 Moravas earlier this year, is expected to place a large order for the improved version as soon as it becomes available for export, scheduled for next year.

The twin-engined, five-seat L200 Morava was designed by Czech engineer Ladislav Smrcek who also designed the Super Aero touring and multi-purpose aircraft now flying in 25 different countries. Russia alone purchased a total of 230 Super Aeros for Aeroflot.

The new version on show at Brno was powered by two air-cooled, six-cylinder M 337 fuel injection engines with supercharger as a replacement for the two 160 hp. Walter Minor 6-III engines which previously powered the Morava. Maximum rating of the M

L200 Morava A Data

Dimensions	
Span	39 ft. 4½ in.
Length	28 ft. 2½ in.
Wing area	186 1/7 sq.ft.
Cabin dimensions	
Height	4 ft. 1¼ in.
Length	4 ft. 3¼ in.
Weights	
Empty weight	2,645 lb.
Gross weight	4,078 lb.
Maximum takeoff weight	4,232 lb.
Useful load	1,378 to 1,543 lb.
Performance	
Maximum speed	192½ mph.
Cruising speed	173¾ mph.
Ceiling on two engines	21,653 ft.
Takeoff distance	721 ft.
Takeoff distance to clear 49 ft.	1,804 ft.
Landing distance	820 ft.
Range on nominal power at 6,561 ft.	1,055¾ mi.
Fuel consumption on nominal power	19.8 gph. 7.2 gal./62 mi.

FACTS the aviation industry should have on commercial uranium

Uranium has many interesting properties.

For example, Davison Uranium has exceptional density — 68% *greater than lead* and about equal to gold. This indicates usages as counterweights in aircraft, shipbuilding, tool making industries — wherever high weight and low volume are factors. It alloys readily with many metals including aluminum, chromium, copper, iron, manganese, molybdenum, niobium, nickel, silicon and zirconium. Corrosion resistance is increased when uranium is alloyed with one of these metals. Davison Uranium possesses high tensile strength and low thermal expansion. While fairly hard (Brinnell 240) at room temperature, uranium becomes very malleable as temperature rises. At 1100°F. its hardness drops to about 20.

Is Davison Uranium easy to fabricate?

Davison Uranium may be melted and cast into any desired shape. It may be formed by extrusion, drawing, rolling, swaging, pressing or forging.

You can machine Commercial Uranium with conventional carbide-tipped machine tools, bearing in mind that it has work-hardening characteristics similar to those of stainless steel.

How about welding?

Success in welding Davison Uranium has been achieved using the Heliarc and shielded arc-consumable electrode process. At this date experiments continue in joining uranium to uranium by brazing or soldering.

How has Commercial Uranium been used?

Present applications in the Aviation Industry are counterweights and static balances. Application in other industries includes shielding materials, telatherapeutic heads, isotope containers. And for many years, uranium has been used as color agents and glazes.

Is Davison Uranium safe?

Radiation hazards are minor. AEC tests indicate a *week's exposure* to depleted uranium is only about *1/10th to 1/100th* the radiation received from an *ordinary chest X-ray.*

Must special storage precautions be taken?

Uranium metal (except fines) can be *handled and stored with methods similar to those used with any other massive metal.* Fines, however, are flammable and should be stored under oil or water.

Is Commercial Uranium expensive?

Not at all. For example, in lots of 1400 pounds or more Commercial Uranium is priced at just $4.60 per pound — considerably cheaper than other heavy metals, with the advantage of superior density.

Need more information?

A letter will bring you additional details for the application of Commercial Uranium to your products or processes. Write today to Department D109, Erwin, Tennessee.

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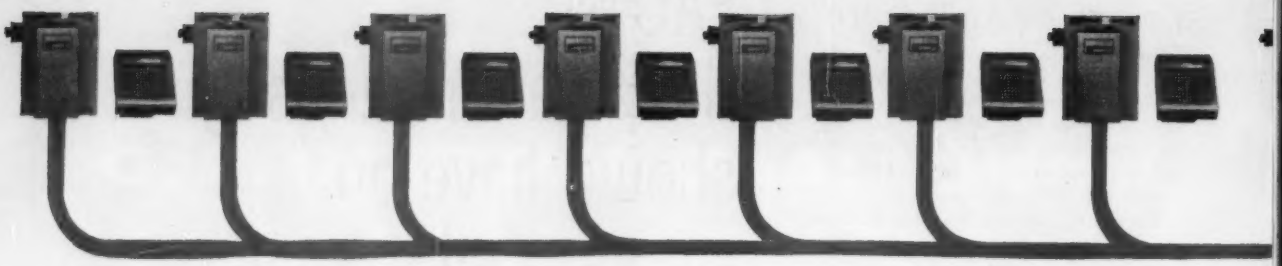

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Production line data must be "live" to be of use in management decisions. The new IBM 357 Data Collection System now makes this information available as soon as it occurs . . . in readily usable punched card form. The IBM 357 increases the volume and speed of data flowing from production line to management, yet drastically reduces the amount of paper work involved.

Each central receiving station of an IBM 357 System is served by up to 20 compact, wall-mounted input stations, strategically located near work areas to receive factory data directly from the production line. Facts fed into the input station are flashed to the recording center and automatically punched into IBM cards, ready for immediate processing. The IBM 357 System is compact, economical, flexible. It can be expanded or modified at any time to handle changing needs.

What Automatic Data Collection with the IBM 357 System can mean to:

MANAGEMENT—Improved operating control based on timely, valid production facts

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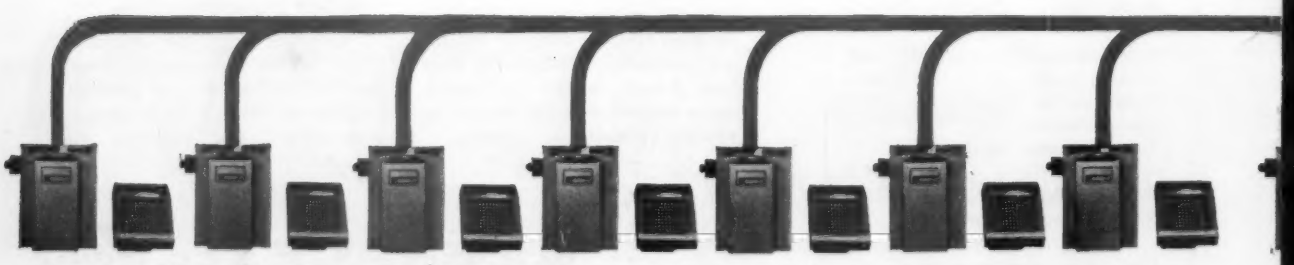
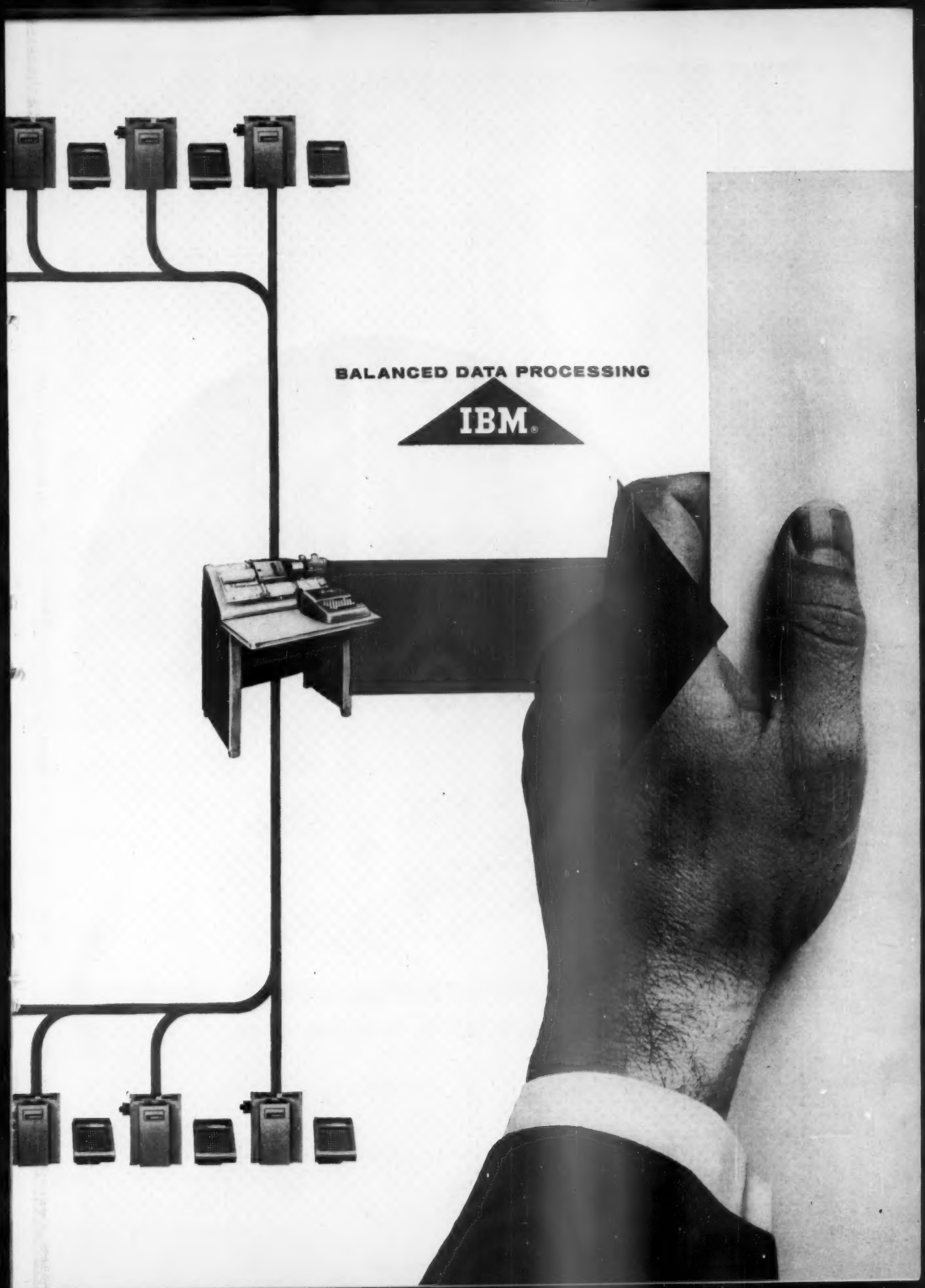
INVENTORY—Closer control of stock due to timely reporting of shortages, overproduction and scrap

MAINTENANCE—Up-to-the-minute record of machine status • Faster schedule adjustments • Immediate location of service personnel

Your local IBM representative can tell you about the many advantages of the new IBM 357 . . . call him today. IBM 357 Data Collection System, like all IBM data processing equipment, may be purchased or leased.

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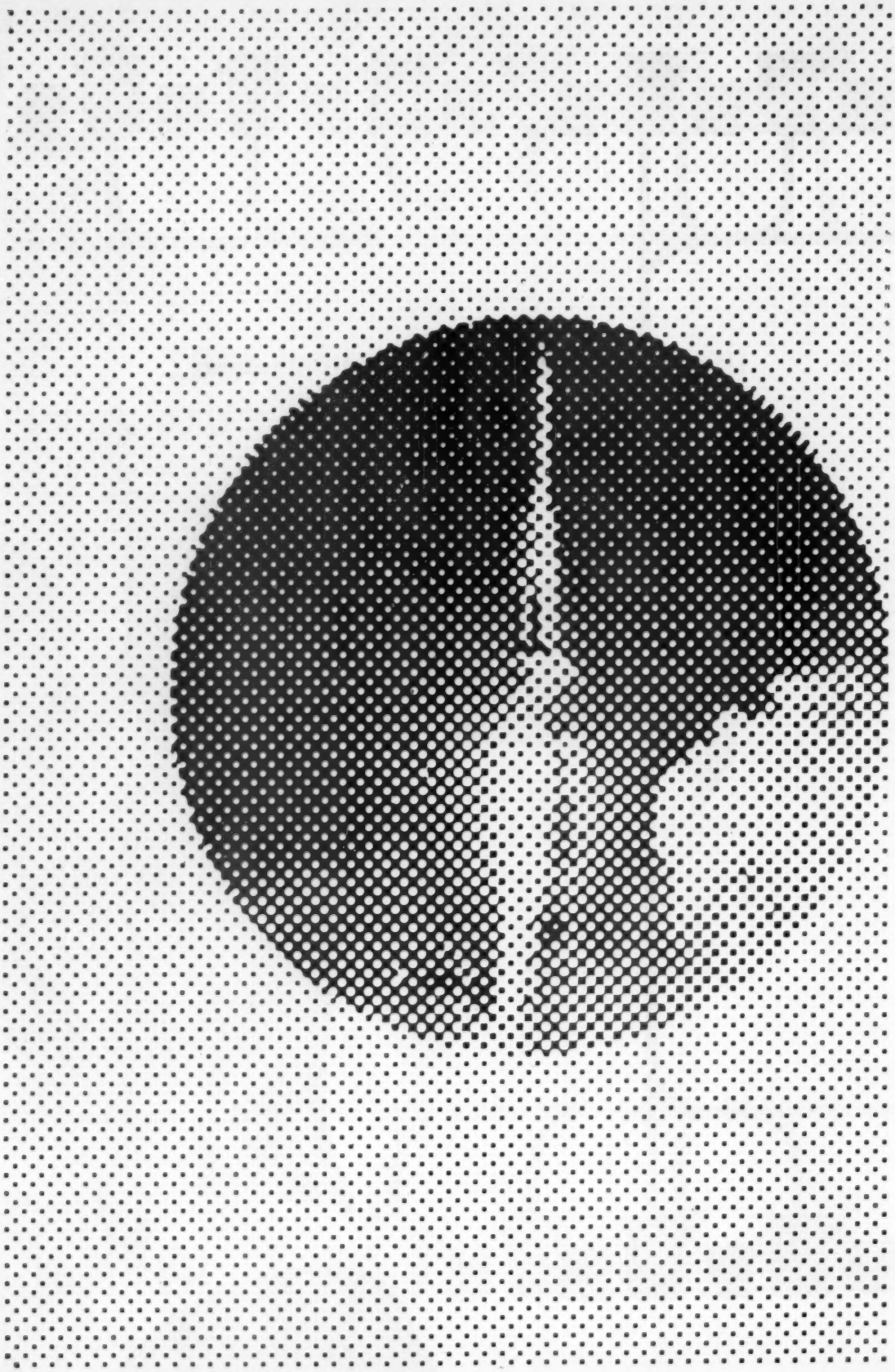


There are 7,500 dots shown here.

This is the number of engineers in the eight divisions of Martin. And 40 percent of these—the 3,000 dots in the circle—are electronics/electrical engineers.

It is this specialized capability that enables Martin to develop electronic systems which anticipate the exacting demands of the missile-space age.

Example: A Martin electronic system known as Master Operations Control (MOC) has been a vital factor in the exceptional performance of TITAN. By automatically checking the hundreds of systems necessary to successful flight, MOC has removed much of the human error from complicated countdown procedures.

MARTIN

The eight divisions of The Martin Company are Activation, Baltimore, Cocoa, Denver, Nuclear, Orlando, RIAS, and Space Flight.

337 engine is 210 hp. at 2,750 rpm., maximum continuous power is 175 hp.

Both the M 337 and another new powerplant, the M 332 of 140 hp. at 2,700 rpm., were introduced and featured prominently at the Brno trade fair as the latest types of Czech aircraft engines designed for small sport and transport aircraft.

The L200 Morava A is available in two versions: as a five-seat touring plane or as an ambulance capable of carrying two patients on stretchers, the pilot and a doctor.

The cabin, which has a hot air installation, can be entered from both sides through doors opening in flight direction. There are two baggage compartments, one behind the rear seats for small items, the other aft of the cabin and accessible only from the outside.

The electrically operated V 410 metal propellers are directly driven and have four different pitch settings which can be controlled during flight.

The fuselage is of all-metal, semi-monocoque construction. Elevator and both rudders are fitted with trim tabs.

All-metal, two-spar wings have Frise-type ailerons and hydraulically operated flaps wtih an electric position indicator.

The tricycle, retractable landing gear of the aircraft is hydraulically operated; nosewheel is steerable. Main wheels are fitted with hydraulic brakes, and both landing gear and flaps also have an emergency hydraulic system actuated from a hand pump.

The main fuel tanks are located in the wing tips and auxiliary fuel tanks are in the wings. Fuel system enables feeding either engine from any tank.

The aircraft has a liquid propeller de-icing system and the wing leading edges are also protected against ice, although Omnipol did not explain how this is achieved.

Electric power is delivered from two 600-watt generators and a 30 amp./hr. battery. The battery enables the engines to be started when necessary without the aid of an outside power unit.

Full blind flying equipment is an optional extra.

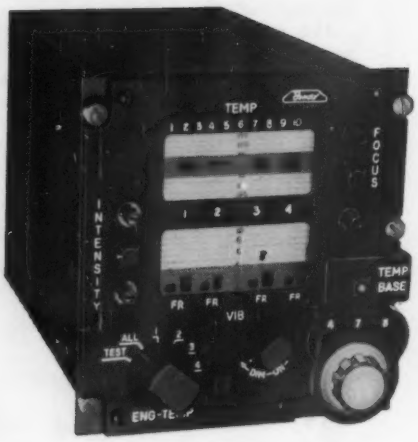
PRIVATE LINES

Piper recently delivered the 7,000th PA-18 series utility airplane, a Super Cub spray-duster, to El Salvador, Central America.

Debonair is name chosen for Beech Aircraft Corp.'s new four-place Model 33 business plane (AW Sept. 28, p. 31), on which production deliveries begin this month.

Two Hiller 12E helicopters have been delivered to Mexico's government-

ANNOUNCING A NEW DEVELOPMENT BY BENDIX



TEMPERATURE VIBRATION MONITOR*

FOR TURBINE ENGINES

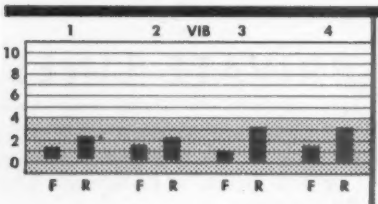
Provides a continuous condensed display of turbine engine vibration and temperature conditions

A landmark in engine instrumentation progress is the Bendix* Temperature-Vibration Monitor which simultaneously displays the findings of 40 temperature and 8 vibration sensors strategically located on all 4 engines of a turbine powered aircraft. This data is presented on the flight deck of the aircraft in bar graph form so that it can be continuously monitored and easily read.

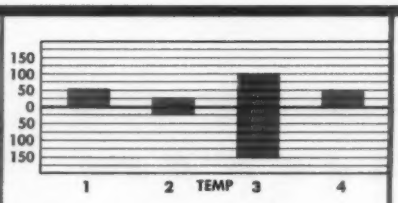
The average displacement of 8 vibration pickups is displayed continuously on the lower cathode ray tube with the top of the bar graph indicating vibration displacement on the grid scale. This continuous monitoring of vibration immediately indicates excessive unbalance on the jet engine.

The temperature analysis normally associated with the exhaust gas thermocouples will locate faulty burners, bad combustion distribution and plugged nozzles or any unusual hot or cold conditions around the turbine engine exhaust. The temperature display in the "all" position presents maximum and minimum temperatures on the upper cathode ray tube continuously for the four engines as reference to a temperature datum set in by the operator. The individual engine temperatures can be displayed as 10 bar graphs whose deflection can be read on the tube scale as deflections above or below the temperature datum, and individual degrees may be accurately and easily read from the digital read-out dial.

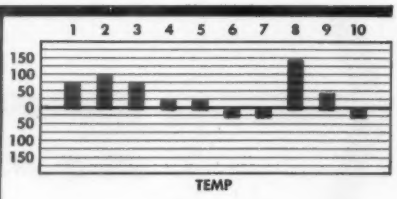
The equipment, initially developed for BOAC, is applicable to all airline and military turbine powered aircraft. The equipment for the four engine installation is approximately 30 lbs. and includes the Temperature-Vibration Monitor pictured above and a remotely mounted ½ ATR short box. *TRADEMARK



Vibration indication for four engines with front and rear pickups on each. Height of display indicates total vibration displacement.



Temperature "all" display indicating maximum and minimum temperatures above and below temperature datum for four engines.



Temperature for single engine indicates all thermocouples indicating temperature above or below temperature datum reference.

Scintilla Division
SIDNEY, NEW YORK

Bendix
AVIATION CORPORATION

owned Petroleos Mexicanos (PEMEX) for transport of personnel and supplies to offshore oil rigs in the Gulf of Mexico and in inland areas for oil and gas site exploration, survey, road planning and pipeline patrol.

Airway Underwriters, an aviation insurance company headed by Robert Crawford, has been organized at Ann Arbor, Mich., to write insurance on single engine and light twin engine aircraft in that state.

VHF radio, especially designed for helicopter installation, has been placed on the market by Nova-Tech, Inc., Manhattan Beach, Calif. Model HR-1 transceiver can handle 23 channels, has a range of about 30 mi. at 900 ft. altitude. Power output is 1½-2 watts. Unit, designed originally for Hughes 269-A two-place helicopter, weighs 3 lb.

Canadian government will finance a $1.3 million hydro-power and irrigation aerial survey of the Mekong River in Southeast Asia, utilizing all of Canada's principal air survey companies. Job includes air photography, ground survey and compilation of maps. Photographic Survey Corp., Toronto, is project manager. Companies participating are Aero Surveys, Ltd., Vancouver; Canadian Aero Service, Ltd., Ottawa; McElhanney Nelson Air Surveys, Ltd., Vancouver; La Compagnie Photo-Air Laurentides, Quebec City, and Spartan Air Services, Ltd., Ottawa.

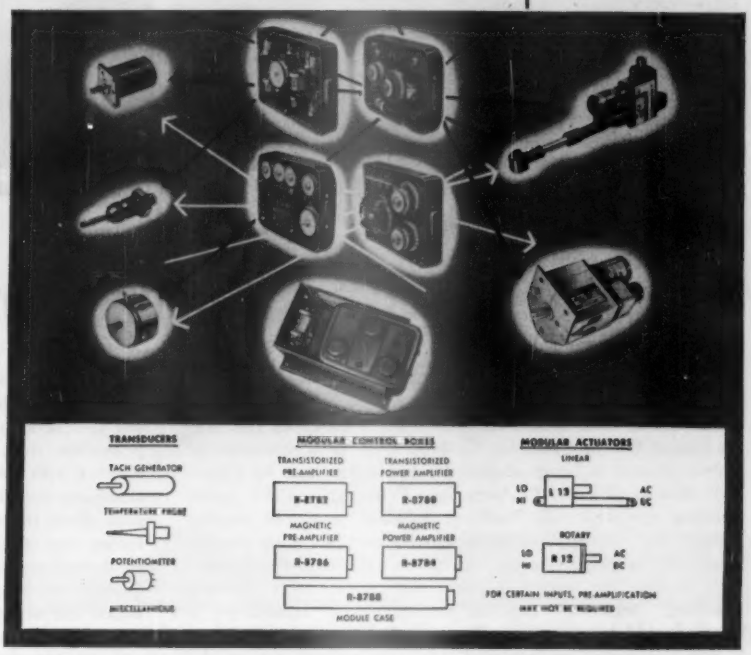
Mississippi Valley Helicopters, Inc., has received a contract from the Ralston-Purina Co., St. Louis, to provide local helicopter service for company officials, visitors and technical personnel between various plants and Lambert-St. Louis Municipal Airport. Negotiations are under way to construct a permanent heliport on Ralston-Purina's headquarters building roof.

Consumer list prices for 1960 models of three Beech executive planes are: Super G18, $126,000, an increase of $3,500 over last year; H50 Twin Bonanza, $95,000, up $3,000, and D50C Twin Bonanza, $83,000, up $2,500.

Initial public offering of 200,000 shares of common stock of Southwest Airmotive Corp., Dallas, Tex., business aircraft sales and service center, was oversubscribed. Offering started at an asking price of $4.75. Half of the income went to Southwest Airmotive's treasury and half to company officials disposing of portions of their holdings. Over-the-counter offering was handled by an underwriting group composed of Rausch, Pierce & Co., Inc., and Dallas Rupp & Sons, Inc., both of Dallas.

Now—Modular Control Systems

New Airborne concept saves design time, helps you get faster delivery



Heart of Airborne's new modular control systems is a contactorless control package consisting of a standardized case (3 x 3½ x 5 in.) into which packaged preamplifier and power amplifier subsystems are plugged. Amplifiers drive actuators having maximum operating loads up to 500 lb. (linear) or 100 in.-lb. (rotary). Modular design permits delivery of relatively complex systems in minimum time.

Over the past 6 years, Airborne has designed and produced a number of special electromechanical control systems for aircraft-missile use. While these have differed in their functions, many of them have nevertheless employed essentially similar components. Thus our policy has been to seek increasing standardization of parts through modular design—to the point where we can now offer complete systems engineered under this concept.

From transducer through actuator, these new Airborne systems are assembled entirely from standardized, interchangeable components. For many applications, you can design around these packaged systems as they stand—and thus reduce engineering time, lead time, and costs. In other instances, slight modifications of the modular units provide the basis for immediately available systems.

Get complete information on this latest Airborne development by requesting new Bulletin PS-5A. If you feel your requirements are unique and cannot be met with standardized units—however flexible—we still invite your inquiry. As mentioned, Airborne offers an extensive background in custom systems—for temperature control, servo control, and positioning.

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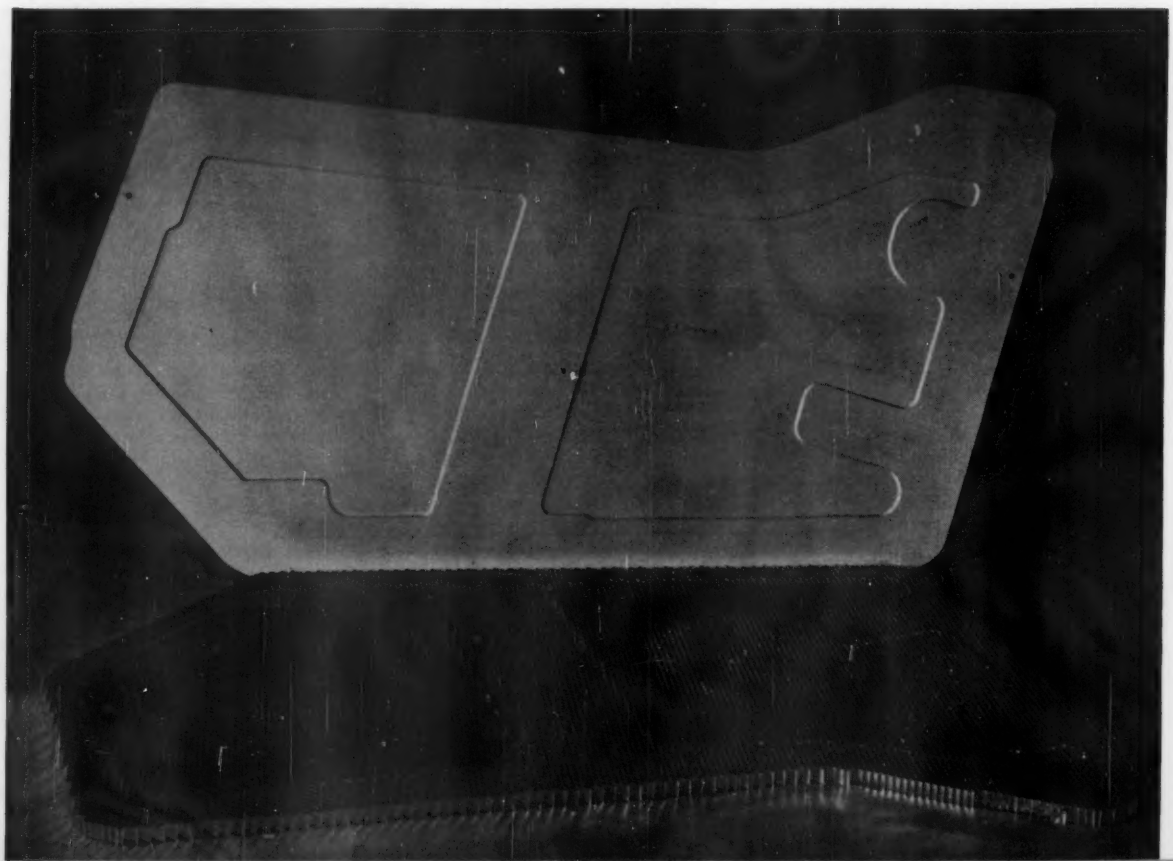
Plaster negative is coated with chemical-resistant masking compound (left); at right sealer is pulled from the honeycomb.

Northrop Uses Chemical Milling for Honeycomb Shape

Northrop Corp.'s Norair Division has developed a system of chemically milling honeycomb structures for production of difficult contours, such as inside double curvatures. Form shown on this page is a landing gear strut door for Northrop T-38 Talon supersonic jet trainer. Process is being adapted for production uses by Chem-Mill Division of Turco Products, Inc., Wilmington, Calif., under a license agreement with Northrop. Method consists of pressing a block of expanded honeycomb into a frangible, water soluble, plaster-like "negative" representing the reverse side of the contour, then masking the exposed portion of the honeycomb cells and dissolving "negative." Exposed portion of the honeycomb is then removed by chemical milling. A plastic compound—Turco-form Mask 150—is used to coat the negative, applied at room temperature by brush or spray. Aluminum 5052 and 3002, steel 15-7 and 17-7 honeycomb cores have been milled by this process. On production runs, tolerances of plus or minus .005 have been achieved with steel and aluminum cores, plus or minus .003 with aluminum and .002 with steel. Company said the Talon strut door, about 16 in. wide, 36 in. long and ¾th in. thick has a total tooling cost of $800 for chemical milling, compared with $3,500 for machining and crushing processes of forming. On a five per unit quantity run of a total production quantity of 10, the chemical milled unit would cost $285, a sum Norair compared with $619 for the same units produced under the machined and crushed method.

Contoured honeycomb core is shown below with matching aluminum skin after completion of the chemical milling process.



Curtiss-Wright Demonstrates VTOL

Santa Barbara—Curtiss-Wright will fly its VZ-7AP Army VTOL test vehicle some 30-35 hr. in proving feasibility of the single engine, four-propeller configuration which was designed to requirements calling for a quarter-ton of freight or cargo or four-person payload, a speed of 50 mph. and a 30 min. flight duration.

Curtiss-Wright testbed demonstrated here publicly for the first time recently, has been popularly dubbed an "aerial jeep" along with similar projects at Piasecki Aircraft Co., and Chrysler Corp., since specifications for the aerial and ground vehicles in respect to speed and load are very similar. The Chrysler Corp. project was canceled after the vehicle crashed (AW Sept. 28, p. 39).

Longest flight time recorded so far by the vehicle is 25 min., and sufficient fuel was left to achieve the design time, Curtiss-Wright indicates. During the public flight demonstration, observers noted that Curtiss-Wright test pilot C. Roger Gardner appeared to have no trouble controlling the machine, despite its apparent extreme sensitivity. Gardner says the machine is "amazingly stable."

CURTISS-WRIGHT Army-sponsored VTOL test vehicle, VZ-7AP, flies during its initial public showing. Pilot Rodger Gardner flew the four-propeller research vehicle four separate times during the demonstration, for a total flight time of more than 15 min. During the demonstration the vehicle was flown forward, in the hover, and to left and right laterally. It also was flown to approximately 12 ft. above the surface of the ground (from wheels to ground), but only about 10 mph. in forward speed. The vehicle so far has approximately two hours in actual flight time, although running time of the engine, gear box and, propellers at operational speeds exceeds 14 hr. Flight time on these components is counted by helicopter rotor system standards; that is, all rotating time is counted rather than actual off-the-ground flight time. Curtiss-Wright also demonstrated its Skydart target, Turbomite turbine and Demon missile checkout system.

Vehicle Funding

Vehicle currently is operating on funds supplied by Army Transportation Research and Engineering Command (TRECOM) under its original contract. However, when these funds are exhausted, there will be no more from TRECOM. Funding ended in September but if the program is eventually carried further, funds will be supplied by the Army Transportation Corps.

Although there have been no concrete formal operational vehicle designs, Curtiss-Wright has sketched several based on the four-propeller configuration for various missions at various gross weights. Included are several with propellers above the cabin, rather than below as on the testbed. Generally, designs are predicated on a payload to gross weight ratio of 25%.

VZ-7AP Development

VZ-7AP development began at Curtiss-Wright in early 1957 when a proposal was made to Army in answer to an Army specification which was originated by the infantry. Work under a contract was initiated in mid-1957.

Four-propeller design of the VZ-7AP is credited to Dr. Richard Vogt of Curtiss-Wright's Santa Barbara Division. According to Dr. Vogt, the four open propeller configuration was chosen over four ducted or shrouded fans for several reasons.

While a shroud will increase lift, it also has an increased momentum drag, Dr. Vogt indicated. Also, in natural pitch oscillations, the time period is six seconds and amplitude is increased by a factor of six by the fourth oscillation in the undamped or unaugmented condition. However, for the unshrouded configuration, the period is 18 sec. and amplitude expansion is only by a factor of 1.2 or 1.3 at the most for the same number of oscillations.

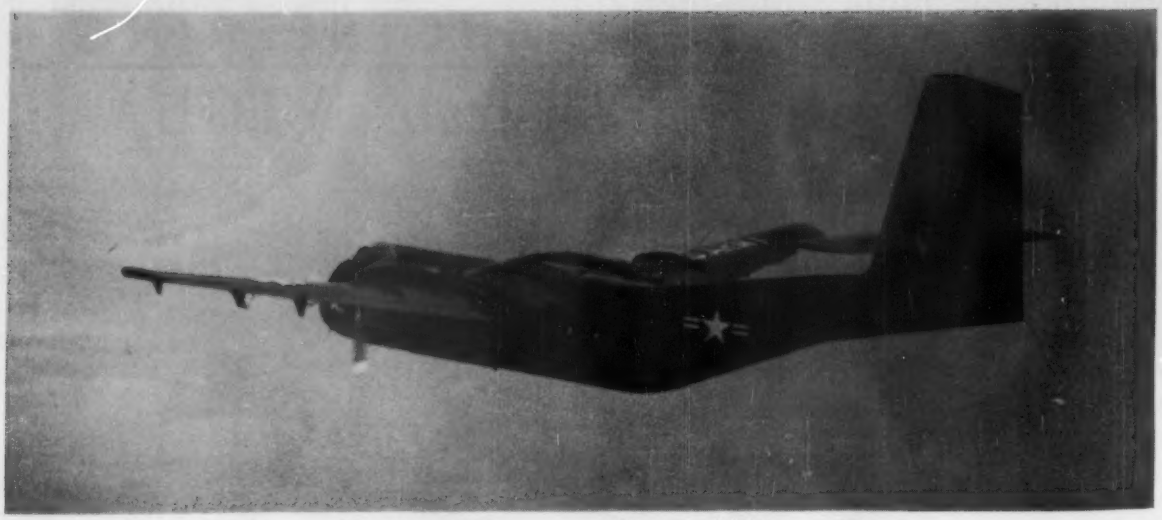
Shrouded Configuration

Another problem, Dr. Vogt said, is the greater inclination angle required for forward flight at the design speeds. A shrouded configuration would have to be inclined 40 deg. nose-down to fly 60 mph. while the unshrouded configuration can accomplish the speed with about 8 deg. nose-down according to the designer.

Test Inspections

During the test program so far, in which running time for the machine's gear box and propellers is more than 14 hr. (all running time counts rather than just airborne time), there have been constant inspections between flights of the gears, shafts, housings and other components of the propeller drive systems, in an effort to determine an estimate for maintenance, replacement, or overhaul time on the parts of the system.

Originally the VZ-7AP had fully articulated blades on the propellers, but the links were blocked off soon and only the flappers now operate. The blades are of fairly low aspect ratio—about 6—and are fabricated of lami-



Army Caribou Transport Starts Military Tests

De Havilland YAC-1 Caribou STOL troop and cargo transport has started initial testing for its military applications at Edwards AFB, Calif., Flight Test Center. Plane is one of five ordered for testing by U. S. Army (AW Oct. 19, p. 125) and is powered by two Pratt & Whitney R2000 1,450-bhp. engines. Fuselage has been extended 47 in.

nated glass fiber. Propeller diameter is 80 in. and at current gross weight, disk loading is 18 psf.

Observers have indicated that the VZ-7AP program has gone well, in view of the fact that there are no spare parts. Efficiency has increased to the point where for every hour of running time, the testbed gets at least 40 min. of actual off-the-ground flight time.

Testbed instrument panel contains standard flight gages plus engine rpm., exhaust gas temperature, oil temperature gage for engine and a gage for the main gear box plus each individual propeller gear box. A problem here is that there is only one gage and a selector switch must be used, and since both hands are needed to control the machine, gear box temperature gage switching is done when the testbed is on the ground.

Chip Detector

Chip detectors also are installed in the main gear box and each prop gear box, with five red warning lights on the instrument panel, since for the gear boxes the lubricating oil also serves as the prop angle governor actuating fluid, and one tiny chip could cause trouble.

VZ-7AP is powered by a Turbomeca Artouste II gas turbine engine manufactured in this country by Continental Aircraft and Engine Co. Engine is being run at 425 eshp. for this installation and, during flight, turns at about 600 rpm.

Start system of the Artouste is self-contained; operation is accomplished simply by turning the start switch to the "on" position. Fuel control also is simple, with "off," "start" and "on" positions. While no formal check has been made, fastest cycle so far was 35 sec. from the time the start switch was turned on until the VZ-7AP became airborne.

If a second VZ-7AP test vehicle is constructed, it will use the Artouste IIC engine which is rated at 500 eshp., increasing testbed performance.

Centrifugal Clutch

Power from the engine is transmitted through a centrifugal clutch to a central gear box from which the four propeller shafts project radially. Normally the clutch remains engaged at all times, and when the engine starts, rotors also start. Shaft and propeller normal speed is 1,150 rpm., although the machine reportedly has been run as high as 2,350 to 2,400 propeller rpm.

The main gear box, propeller shaft housings and the propeller gear boxes are an X-shaped, rigid structure, the gear boxes of 356-T-6 aluminum alloy casting, the shafts housings of built up aluminum alloy 2024-T-4 channels and sheet metal. This "spider," as it is called, when bolted to the parts of the airframe carrying the pilot seat, load platform and fuel cells, becomes the test bed primary structure. Main spider could be adapted to other structural configurations, such as those carrying a load slung under the spider instead of on top.

Airframe is fabricated from sheet metal sandwich panels having clad aluminum alloy faces bonded to aluminum honeycomb core. Metal honeycomb is used on all surfaces of the box beam structure as well as for bulkheads. Panels are riveted at the edges to longitudinal and transverse aluminum alloy angles. The rigidity and damping afforded by the sandwich construction practically eliminates panel vibration. Curtiss-Wright engineers say that a structure of this type can be assembled with a minimum of jigs and tools.

Central gear box, propeller shafts and hubs were conceived and developed as a joint effort by Curtiss-Wright and the Sargent Engineering Corp. of Los Angeles. Transmission system was manufactured and given simulated service tests by Sargent.

Smaller Bearings

The central gear box has two spiral bevel pinions mounted face-to-face on a single shaft so that gear loads are virtually canceled, permitting the use of smaller bearings and housing. Each of the two bevel pinions drive two gears which, through intermediate shafts, drive the four propeller gear boxes, inside which a pair of spiral bevel gears completes the transmission to the propellers. Propeller gear boxes contain integral hydraulically-operated propeller pitch control actuators. Control inputs are transmitted by the pilot through cables directly to slide valves which control the position of a piston linked directly to the propeller blades.

Entire hydraulically-powered propeller pitch control system is inside the oil reservoir within the propeller hub except for the power cylinder and control valve. No lines or fittings are used in the system. Check valves, relief valves, pumps, etc., are all modular, plug-in type installations. Two parallel pumps are provided, which is the only instance in which dual components are used, according to Sargent.

All four propeller gear boxes are pro-

vided with self-contained, independent hydraulic systems in which the gear box lubricant also serves as the working hydraulic fluid.

Control system consists of conventional stick and rudder for controlling movement about the pitch, roll and yaw axis. A collective pitch lever, located to the pilot's left, is used to adjust vertical movement. Power control consists only of a push-pull lever to turn on the fuel supply to the engine and a trim knob to set engine rpm. Once set, a governor holds the rpm. constant regardless of engine load.

Roll Improvement

Roll movement is controlled by lateral stick displacement which in turn changes pitch of the propellers on a respective side. Thus, if the stick is moved to the left, pitch of the left hand propellers will decrease while increasing on the right pair. Similarly, fore and aft movements of the stick change pitch of the respective front or rear pairs of propellers. A collective pitch lever changes pitch of all four propellers for vertical movement while a mixer box enables combinations of elevator and aileron movement to be introduced to the propeller pitch control valves.

Yaw axis control is achieved by rudder pedal movement which changes, through cables, the angle of deflection of a vane in the exhaust efflux and the angle of other vanes mounted under each of the rear fans. Originally, Curtiss-Wright engineers deemed the exhaust vane adequate for directional control, but this did not prove out in initial flight tests made Sept. 3. Only about 75 lb. thrust leaves the tailpipe and proved insufficient for directional control even though there is no torque effect.

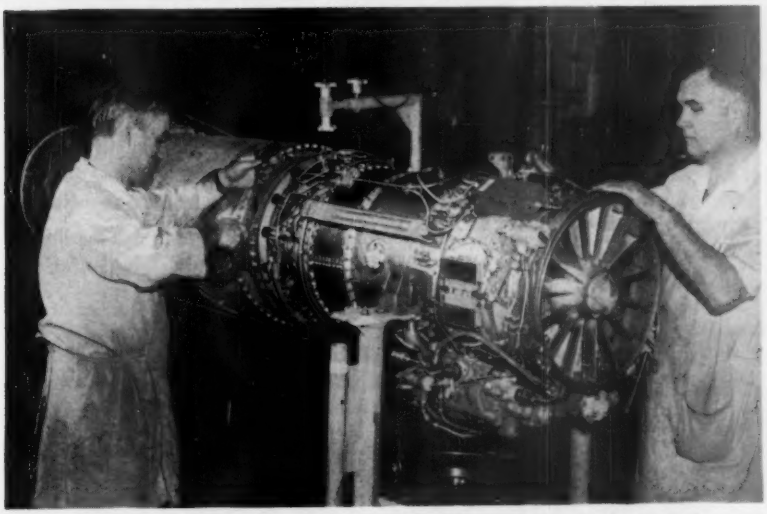
Yaw control is achieved by direct cable linkage from rudder pedals to the vanes under each aft fan and in the exhaust efflux.

Central gear box and each of the propeller hub gear boxes contains its own independent oil supply and lubricating system. It is not possible for a leak in any one system to drain the other systems, but the nature of the machine is such that a malfunction of any of the propeller hubs is tantamount to immediate shutdown.

Center of gravity of the testbed is ahead of the center of lifts with the result that in hovering flight a greater load is carried by the forward pair of propellers. Project Engineer Walt Wolf said that this loading is necessitated by the fact that during forward flight the front pair of propellers assumes less and less load as forward speed increases. By arranging the center of gravity to be ahead of the center of lift, load on all four propellers is more nearly equal at moderate forward speeds. In a production version, the machine is generally regarded as allowing a pretty wide margin in CG location since the pilot can make up for load errors to a fairly good extent.

Gross Weights

Gross weight of the VZ-7AP is about 2,400 lb. including pilot and full fuel load. Curtiss-Wright says that the machine is capable of operating at sea level at gross weight of 2,950 lb., leaving 550 lb. for payload. Payload



YJ85-5 Afterburning Turbojet for N-156F

General Electric YJ85-5 afterburning turbojet engine for flight test on Northrop N-156F 'Freedom Fighter" (AW Nov. 9, p. 19, 95) is prepared for shipment from the company's Lynn, Mass., plant. Engine is a prototype of twin J85-5s that will power both N-156F and the T-38 Talon trainer version, both powered by J85-1s.

BASIC BUILDING BLOCKS FROM KEARFOTT

Floated Rate Integrating Gyros

Specifically designed for missile applications, these Kearfott miniature gyros operate efficiently at unlimited altitudes. Their outstanding accuracy and performance make them superior to any comparably-sized units on the market. Hermetically sealed within a thermal jacket, these gyros are ruggedly designed and completely adaptable to production methods. Performance characteristics that are even more precise can be provided within the same dimensions.

TYPICAL CHARACTERISTICS

Mass Unbalance:
Along Input Axis: 1.0°/ hr maximum untrimmed
Standard Deviation (short term):
Azimuth Position: 0.05°/hr
Vertical Position: 0.03°/hr
Drift Rate Due to Anisoelasticity
Steady Acceleration: .015°/hr./g² maximum
Vibratory Acceleration: .008°/hr./g² maximum
Damping:
Ratio of input angle to output angle is 0.2
Characteristic Time:
.0035 seconds or less
Weight: 0.7 lbs.
Warm-Up Time:
10 minutes from —60°F
Life: 1000 hours minimum

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But here on board this luxurious airliner you relax in the quiet comfort of the cabin which TWA and Boeing have so tastefully designed. TWA's careful attention to passenger comfort means so much. Specially designed seats and custom interiors create a warm feeling of sheer travel pleasure. No wonder the evening seems to have just begun when you touch down at San Francisco International Airport... just 5 hours 45 minutes from Manhattan!

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Macwhyte "Hi-Fatigue" Aircraft Cable is made in a complete line of sizes and types. Macwhyte "Safe Lock" Cable Terminals of stainless steel are available loose or in complete assemblies ready for installation. Macwhyte Aircraft Cables, Terminals, and Assemblies meet the requirements of aircraft manufacturers, airlines, and military specifications. Aircraft Catalog A-3 free on request.

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capacity presently is taken up by telemetry and instrumentation installations.

Tests have not been conducted to determine how much performance will be attenuated by altitude, but some deterioration is inevitable. Specifications call for operational capability at 6,000 ft. above sea level. Altitude at which the vehicle can operate above terrain is not an important criterion, according to Wolf, but operation from high altitude terrain is important, since combat operations often involve high mountains. TRECOM does not require that the vehicle operate at any appreciable altitude above terrain since its mission calls for short hops close to the ground. Machine is actually envisioned as using trees and existing terrain features for cover during operation.

Major reason why the VZ-7AP does not now operate very high off the ground is that the vehicle has no glide or autorotational capibility, or pilot ejection seat in the testbed. However, it is certain that any production models would have the ejection seat, and an escape system would be incorporated in the prototype if it were to operate at any significant height.

DEVELOPMENT costs of 75 hp. regenerative turbine engine exceeded $1 million. Williams, Williams Research Corp. president, inspects rotor section (above).

New Regenerative Gas Turbine May Have Helicopter Application

Detroit—Williams Research Corp., Walled Lake, Mich., has developed a low-cost 75 hp., 75 lb. regenerative gas turbine that may have applications for light aircraft.

For certain military applications, such as lightweight helicopters, a non-regenerative version will be available that weighs only about 50 lb. Reasoning is that during the Korean War, helicopter missions averaged 30 min. in length, so the added weight and cost of the heat exchanger could not be justified in future missions.

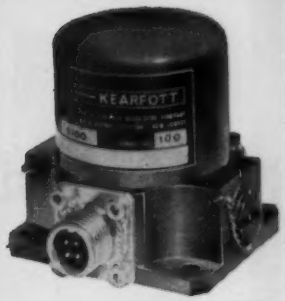
The unit, which is described as being the size of a bread box, is 50% composed of aluminum allow die castings. These castings include gear case, compressor and outer housings. Rotating parts are made from conventional ferrous-alloys.

A test installation, mounted as an outboard motor in an 18-ft. Thompson boat, has been running for 15 months.

Sam Williams, 38-year-old founder and president of the company, says he plans manufacture of aircraft versions in about a year. The unit is scheduled to undergo CAA acceptance tests soon.

Williams, before forming his own business, was a principal designer on the regenerative turboprop engine that Chrysler Corp. developed for Navy Bureau of Aeronautics as well as the basic unit now under development by Chrysler for automotive usage. The latter engine utilizes a rotating heat exchanger.

BASIC BUILDING BLOCKS FROM KEARFOTT



Electrohydraulic Servo Valve

Kearfott's unique approach to electrohydraulic feedback amplification design has resulted in a high-performance miniature servo valve with just two moving parts. Ideally suited to missile, aircraft and industrial applications, these anti-clogging, 2-stage, 4-way selector valves provide high frequency response and proved reliability even with highly contaminated fluids and under conditions of extreme temperature.

TYPICAL CHARACTERISTICS

Quiescent Flow ..... 0.15 gpm
Hysteresis ...3% of rated current
Frequency Response 3 db @ 100 cps
Supply pressure....500 to 3000 psi
Temperature-Fluid & Ambient −65° F to +275° F
Flow Rate Range .... .3 to 10 gpm
Weight ..... 10.5 ounces

Write for complete data.

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The mission:

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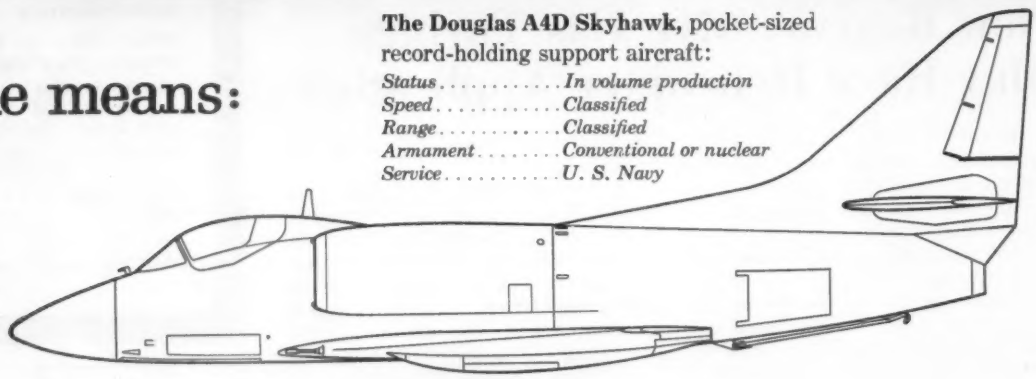
The means:

The Douglas A4D Skyhawk, pocket-sized record-holding support aircraft:

Status . . . . . *In volume production*
Speed . . . . . *Classified*
Range . . . . . *Classified*
Armament . . . . . *Conventional or nuclear*
Service . . . . . *U. S. Navy*



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Second Prototype Avian Autogyro Construction Started in Canada

Georgetown, Ont., Can.—First prototype of a new autogyro type VTOL (AW June 15, p. 103), designed to provide high performance with a simplified long-life structure, is nearing completion here. Work also has started on a second prototype for certification.

The Avian 2/180 Gyroplane features a novel "jump takeoff" system for use in restricted areas and in emergency in event of engine failure. System basically comprises an engine-rechargeable compressed air reservoir which the designers report will boost normal rotor kinetic energy for landing by a figure of five. For VTOL jump takeoffs, this system will provide sufficient energy to boost the Gyroplane to an initial height of approximately 200 ft., they add.

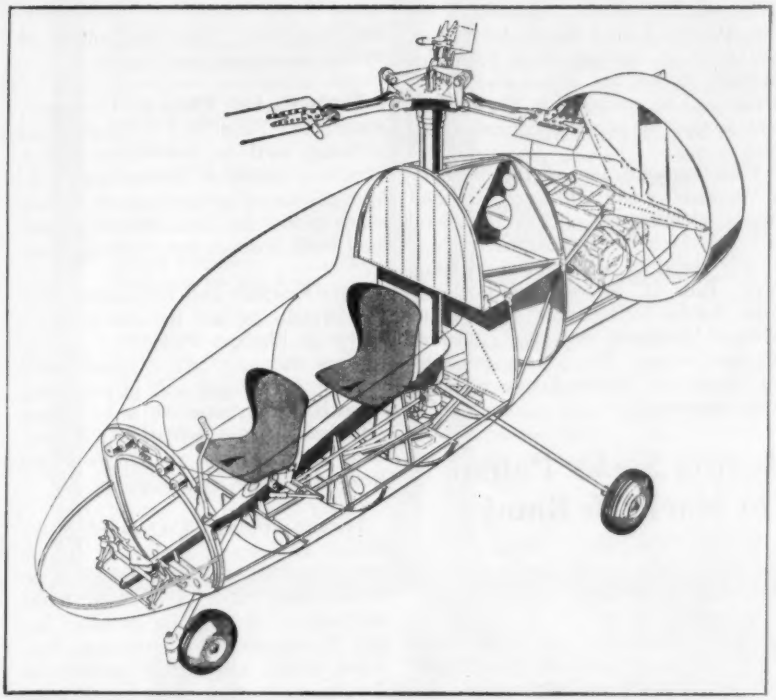
To develop long-life characteristics, Avian engineers have utilized components employing steel in structural areas unless fluctuating stresses in a component are less than 1,000 psi., in which case light alloys are used. Main fuselage structure and all of the rotor system are of steel and it is anticipated that a design fatigue reserve factor of three has been achieved, in effect providing an infinite life for these components, they contend.

Basic fuselage structure comprises a vertical steel tube as the pylon and a horizontal steel tube as the keel of the front fuselage into which all landing gear loads are dissipated and to which seats and other components are attached. Landing gear strut is a single tapered spring steel rod held in a socket by a single bolt.

Rotor blade structure is all steel with a hardwood section forward of the main spar and balsa as the trailing edge section, with reinforced glass fiber skin covering. The Gyroplane does not use drag hinges on the rotor head in order to avoid first harmonic flight vibration and ground resonance characteristics; also, the fundamental in-plane natural frequency of the blade is well above maximum rotor speed.

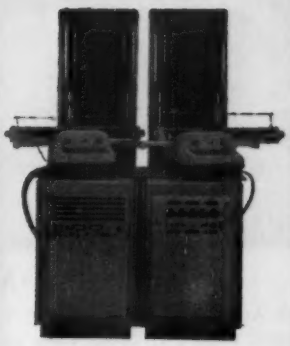
This philosophy results in a relatively heavy blade with high in-plane stiffness. Blade angle of attack is developed entirely by a servo tab control system, providing light control stick forces. High offset flapping hinges are used.

The designers note that the system gives high values of initial angular acceleration and damping in pitch and roll. Maximum rate of pitch and roll is less than 10 deg./sec. at low speeds,



HORIZONTAL STEEL KEEL, around which fuselage structure is assembled, takes Avian Gyroplane 2/180 landing gear loads. Fuselage skin is reinforced fibrous glass. Yaw control is located aft of ducted pusher propeller. Gyroplane will cost about $10,000 and is being built by a group of former Avro Aircraft, Ltd., engineers.

BASIC BUILDING BLOCKS FROM KEARFOTT



Data Logging

Kearfott's broad line of test equipment includes the Scanalog 200-Scan Alarm Logging System which monitors, logs and performs an alarm function of up to 200 separate temperature, pressure, liquid level or flow transmitters. This precise data handling system is equipped with manual controls for scanning rates, automatic or manual logging, data input relating to operator, time, day, run number and type of run. 200 numbered lights correspond to specific points being maintained and provide a visual "off normal" display for operator's warning. System can be expanded to 1024 points capacity and 2000 points per second scanning rate.

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USAF Orders More Link T-37 Trainers

Link Aviation, Inc., will build 35 T-4 flight simulators for Cessna T-37 twinjet primary trainers, under a U. S. Air Force contract. Trainers will be delivered starting next summer to Air Training Command. Link previously delivered 19 of the trainers.

although initial acceleration exceeds minimum military specification requirements.

A maximum speed of 150 mph. at 75% maximum except takeoff (METO) power is anticipated for the Gyroplane. Speed is credited to the aircraft's small size and aerodynamic cleanliness, made possible by ducting the pusher propeller (enabling propeller diameter to be reduced), allowing the aircraft to sit closer to the ground and bringing the rotor closer to the ground. A rudder, or yaw vane, is placed behind the propeller, which the engineers say will increase the efficiency of this control.

Top Officials Named To Weapons Bureau

Washington—Five top posts in the newly-organized Bureau of Weapons, Navy's primary development agency, were filled last week, with the five officers involved scheduled to move into their new assignments in December. They are:

- **Rear Adm. Thomas F. Connolly,** now assistant chief of the Bureau of Aeronautics which the Bureau of Weapons is absorbing, will serve as assistant chief of the new bureau in charge of the Pacific Missile Range and space technology, under present plans. Navy may decide, however, to establish a separate post for space technology.
- **Rear Adm. Joseph E. Dodson,** now assistant BuAer chief for procurement, will serve as assistant chief for production and quality control.
- **Rear Adm. Charles P. Booth, II,** assistant BuAer chief for plans and programs, will be assigned to the post of assistant chief for program management.
- **Capt. Morris A. Hirsch,** assistant chief of the Bureau of Aeronautics for maintenance and support, will become assistant chief of the Bureau of Weapons for fleet readiness.
- **Capt. Bernard M. Strean,** chief of staff and aide to the commander of the Atlantic Fleet's Naval Air Force, will serve as assistant chief for field support. Both Capt. Hirsch and Capt. Strean will be promoted to the rank of rear admiral during the current fiscal year.

Final consolidation of the Bureaus of Aeronautics and Ordnance into the Bureau of Weapons will become effective on Dec. 1 approximately one month ahead of schedule when Rear Adm. Paul D. Stroop believes Rear Adm. Robert F. Dixon and Rear Adm. Miles H. Hubbard, respective chiefs of the two bureaus. The new assignments for Dixon and Hubbard have not yet been announced.

Boeing Seeks Patent On Mach 16 Ramjet

Wichita, Kan.—Boeing Airplane Co. has submitted a patent application on the design of a ramjet engine capable of propelling an aircraft or missile at Mach 16. The engine, still in the drawing board stage, probably would not have any immediate military or commercial application.

Boeing says the engine will operate within the atmosphere at between Mach 6 and 16 (4,000 to 11,000 mph.), probably using hydrogen for fuel.

Feature of the new engine, Boeing officials say, represents a major breakthrough in the ramjet engine field—that combustion can take place at supersonic speeds within the engine.

The engine is designed so that supersonic combustion can take place across a stabilized detonation wave within the engine, thus eliminating the need for decelerating interior air below the speed of sound. Stabilization is accomplished by equalizing interior speed of the air and speed of the detonation wave. As the latter varies, the former is automatically increased or reduced by varying diameter of the air inlet channel and by changing the fuel ratio. Result is a fixed, continuing detonation which provides intense heat for combustion.

These advantages are expected:

- **Simplification** of supersonic inlets.
- **Reduction** of engine weight.
- **Achievement of maximum** energy release rate.
- **Increase** in engine thrust to weight ratios.

Engine needs no ignition system; initial detonation wave heat starts combustion, according to Boeing.

PRODUCTION BRIEFING

Production of a quantity of containers for three components of Army Sergeant surface-to-surface missile will be handled by Temco Aircraft Corp., Dallas, Tex., under a contract from Sperry Utah Engineering Laboratory, Salt Lake City. Containers will be of welded aluminum construction.

Union Carbide Chemical Co.'s new, water-based Ucon M-1 hydraulic fluid is being used in the Titan ICBM launching system at Vandenberg AFB. Material is used in the hydraulic system which moves the Titan into its ground level firing position from underground.

Esso Research and Engineering Co. has formally opened its new scientific center in Florham Park, N. J. Scientists at the new center initially will work on engineering and oil processing research. Other research work, along with headquarters activities, will continue to be carried out at the Esso Research Center in Linden, N. J.

Boeing Airplane Co. awarded the Florida Division of Radiation, Inc., a $476,000 contract to develop a tape format converter for Minuteman ICBM test program. Boeing also awarded Century Electronics and Instruments, Inc., Tulsa, Okla., a $550,000 contract to develop calibration carts for Minuteman. Equipment will be used for calibrating instrumentation before missiles are launched, and will include remote control panels and digital voltmeters and printers.

BASIC BUILDING BLOCKS FROM KEARFOTT

Analog-to-Digital Converters

Kearfott's rugged shaft position-to-digital converters are resistant to high shock and vibration and high and low temperature environments. Ideally suited for missile applications, these converters are available for many uses, including latitude, longitude, azimuth or conventional angular shaft displacement conversion and decimal count conversion. Exclusive drum design provides large conversion capacity in smallest size. Combination counter converter assemblies for both visual and electrical readout also available.

TYPICAL CHARACTERISTICS

Kearfott Unit No.	P1241-11A
Code	Cyclic Binary
Range	0-32,768 (2^{15})
Bits per Revolution	16
Revolutions for Total Range	2,048
Volts D.C.	10.5
Current (ma.)	20
Inertia (gm. cm.²)	20
Unit Diameter (in.)	1¼
Unit Length (in.)	3
Life	10^6 Revolutions or 10^3 hours
Static Torque (in.-oz.)	2 (break) 1 (running)
Weight (oz.)	5
Maximum Speed (RPM)	600

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BASIC BUILDING BLOCKS FROM KEARFOTT

20 Second Synchro

This synchro, just one of a broad line offered by Kearfott, provides the extreme accuracy required in today's data transmission systems. Kearfott synchro resolvers enable system designers to achieve unusual accuracy without the need for 2-speed servos and elaborate electronics. By proper impedance matches, up to 64 resolver control transformers can also operate from one resolver transmitter.

TYPICAL CHARACTERISTICS — SIZE 25

	Transmitter	Control Transformer
Type Resolver		
Part Number	Z5161-001	Z5151-003
Excit. Volts (Max.)	115	90
Frequency (cps)	400	400
Primary Imped.	400/80°	8500/80°
Secondary Imped.	260/80°	14000/80°
Transform. Ratio	.7826	1.278
Max. Error fr. E.Z.	20 seconds	20 seconds
Primary	Rotor	Stator

Write for complete data.

BASIC BUILDING BLOCKS FROM KEARFOTT

Integrating Tachometers

Kearfott integrating tachometers, special types of rate generators, are almost invariably provided integrally coupled to a motor. They feature tachometer generators of high output-to-null ratio and are temperature stabilized or compensated for highest accuracy integration and rate computation. Linearity of these compact, lightweight tachometers ranges as low as .01% and is usually better than ± .1%.

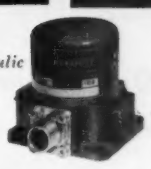
TYPICAL CHARACTERISTICS

	Size 11 (R860)
Excitation Voltage (400 cps)	115
Volts at 0 rpm (RMS)	.020
Volts at 1000 rpm (RMS)	2.75
Phase shift at 3600 rpm	0°
Linearity at 0-3600 rpm	.07
Operating Temperature Range	−54° +125°

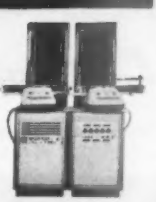
Write for complete data.

Miniature Floated Gyro

Electrohydraulic Servo Valve



Scanalog 200-Scan Alarm Logging System



Engineers: Kearfott offers challenging opportunities in advanced component and system development.

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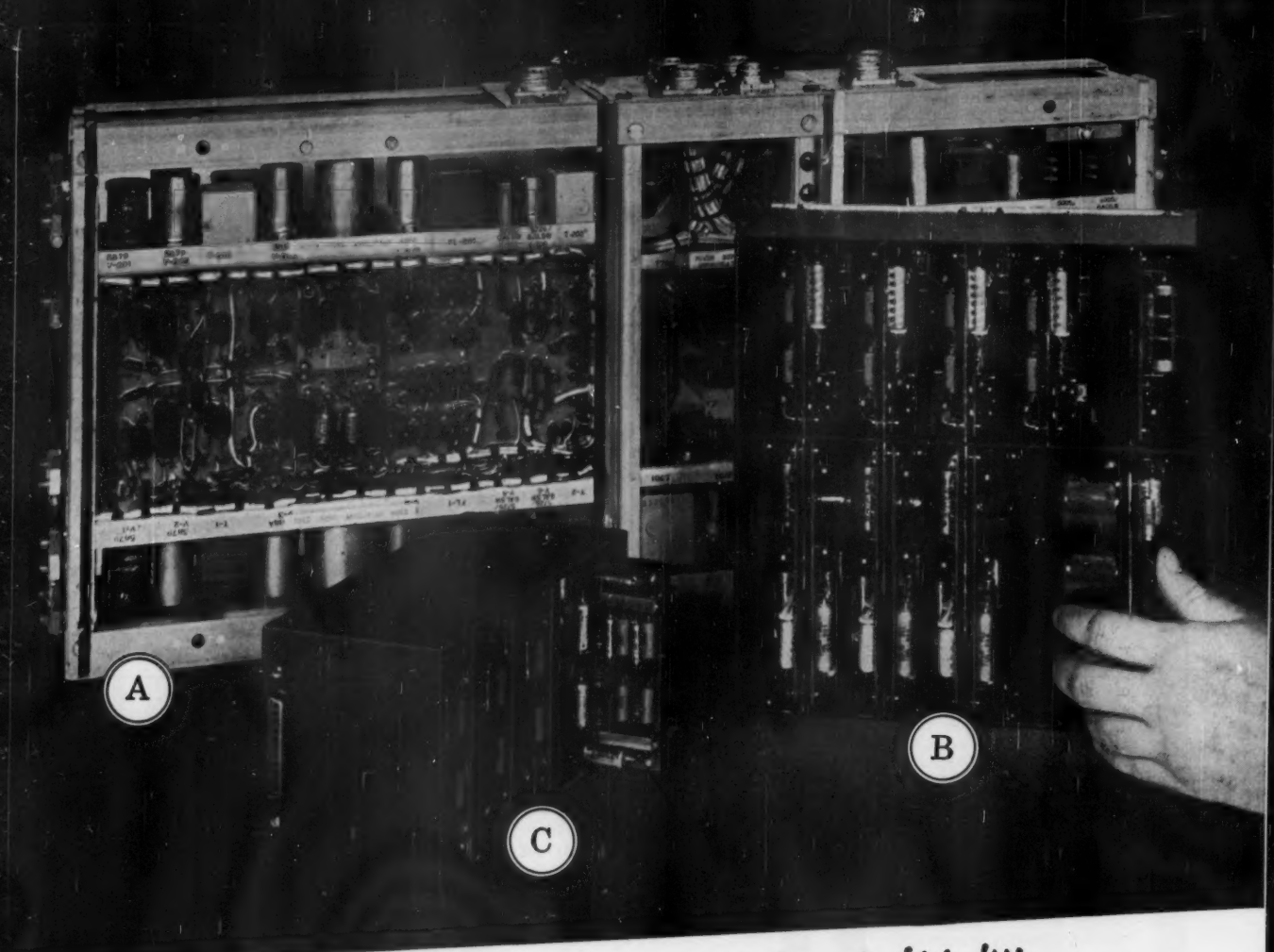

..... DESIGN FOR LESS C/V/W .....

Above are three stages in development, showing Stavid advances in high density packaging. Result: less cost/volume/weight.

Unit A, a portion of a guidance system developed in 1955, was redesigned by Stavid in 1958 to adapt it to mechanized assembly techniques. Although no attempt was made at miniaturization, Stavid achieved a 70% volume reduction and a 60% weight reduction—and added *a regulated power supply.* (Unit B). Unit C is the package, miniaturized through the use of solid state components.

As a result of years of experience in designing for semi-automatic and mechanized assembly, Stavid has developed an important capability . . . that of reducing volume, weight and production costs . . . and at the same time providing greater reliability, producibility and maintainability in all types of electronic equipment, including the most sophisticated systems.

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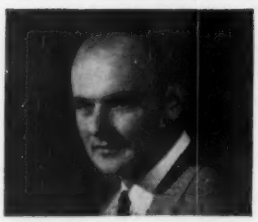

F. T. POLITICA, Special Projects Engineer, has specialized in the development and evaluation of electronic equipment, utilizing mechanized assembly techniques. He is presently engaged in a program of miniaturization involving complex missile systems.

STAVID Engineering, Inc. Plainfield, New Jersey

Imaginative Electronics . . .

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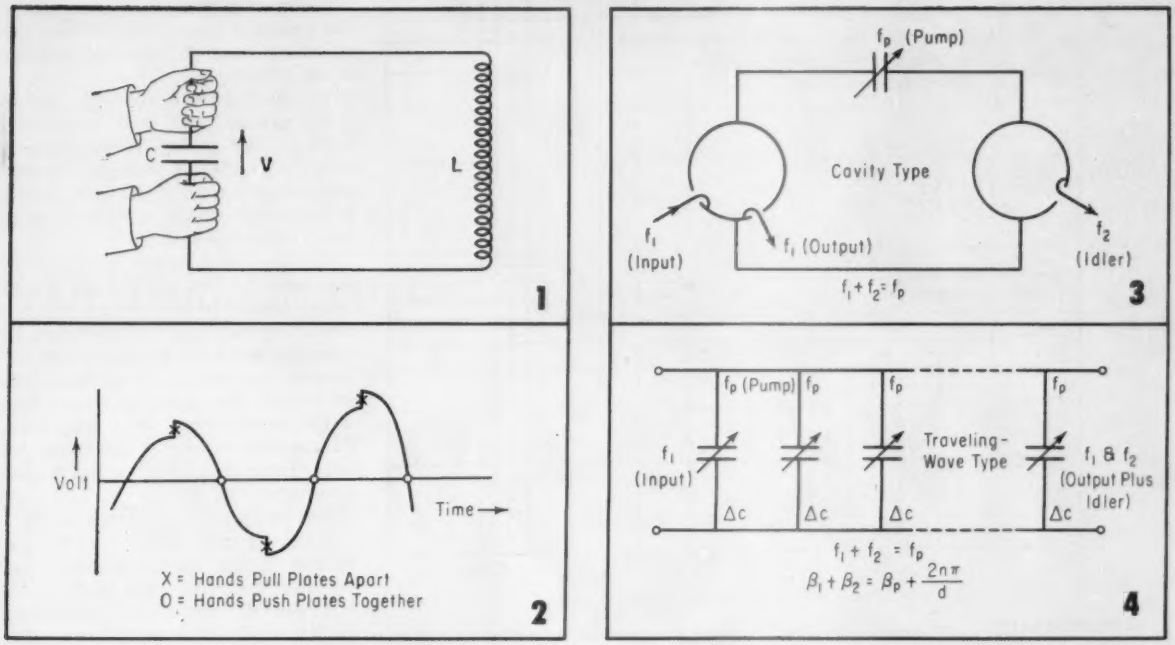


FIG. 1 illustrates principle of parametric amplification, used in new low-noise amplifiers, in terms of simple resonant circuit in which hands pull capacitor plates apart when voltage is maximum, push them back when voltage is zero. Result (Fig. 2) is an increase in voltage across the capacitor. Two types of semiconductor parametric amplifiers use diodes as variable capacitors as shown schematically in Fig. 3-4. Fig. 3 shows the cavity type which is simpler, less expensive, but not as stable nor as wideband as the traveling-wave type shown in Fig. 4. Cavity type requires less pumping power.

Parametric Amplifier Types Increasing

By Dr. Glen Wade*

Improvements in the performance of radar, communication and radio astronomy systems which were inconceivable only a few short years ago have become possible through the use of parametric amplifiers, a new class of device based on a principle first enunciated nearly 100 years ago.

The principal advantage of these parametric amplifiers is that even when operated at room temperature, they can be made to generate very little noise. Consequently, parametric amplifiers can detect extremely weak signals—weaker than can be detected by other microwave amplifiers at room temperatures.

Noise Performance

The parametric amplifier, for many applications, has a noise performance that is superior to that of the backward-wave amplifier even though the latter has been worked on intensively over a longer period of time and is in a more advanced state of development.

For example, the lowest measured noise temperature at present for a backward-wave amplifier operating at 3,000 mc. is about 270 deg. Kelvin, while that of an unrefrigerated parametric amplifier operating at the same frequency is about 70K. For a refrigerated parametric amplifier, the noise figure is even lower. This means that if used in antennas aimed at the cold sky, the parametric amplifier could detect a signal with less than half the power level of the smallest signal that could be detected by the backward-wave amplifier.

However, a simple examination of relative noise temperatures does not tell the whole story and can be quite misleading, in comparing parametric with other types of amplifiers, depending upon the application. For example, because the parametric amplifier is a negative-resistance device, and because it generates an auxiliary signal, known as

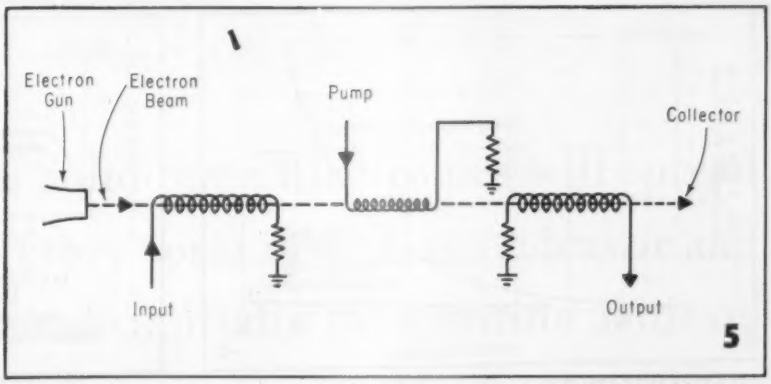
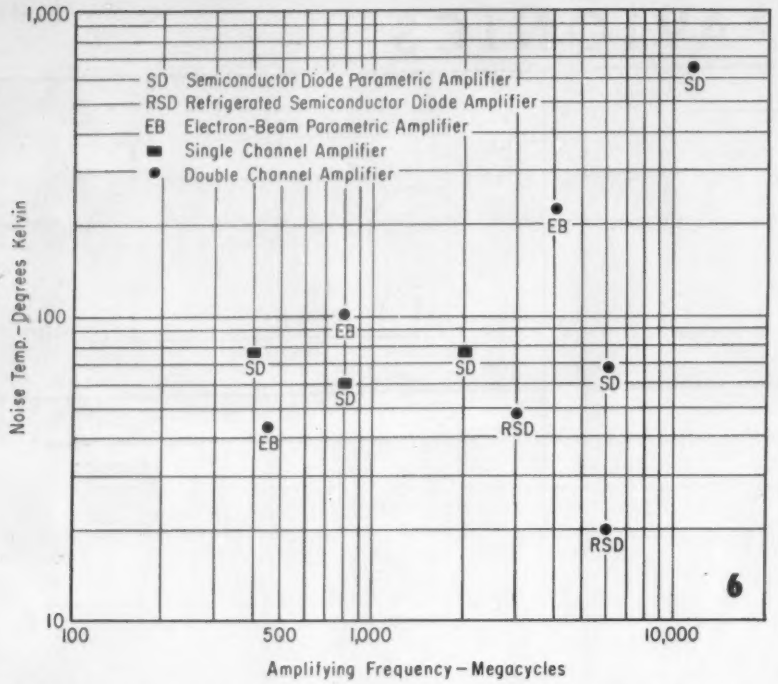


FIG. 5 illustrates electron-beam parametric amplifier which has similar characteristics to traveling-wave diode amplifier, but uses fast waves in an electron beam. Pump produces field which transforms energy to electrons by amplifying their wave motion. Input coupler serves to introduce input signal and to remove noise from the fast waves.

* Dr. Wade is associate professor of electrical engineering at Stanford University.



REPRESENTATIVE excess noise temperatures achieved in semiconductor and electron-beam parametric amplifiers as a function of operating frequency and type of operation.

the idler signal, its noise behavior is markedly different from that of a backward-wave amplifier.

In a number of applications the idler signal is a nuisance and must be kept from interfering with the signal to be amplified by filtering out the idler frequency from both the amplifier input and output. When filtering is used, this is referred to as a single-channel operation; when filtering is not employed, it is called double-channel operation. The measured noise temperature under single-channel operation is often significantly higher than that under double-channel operation. (The noise temperature comparison between parametric and backward-wave amplifiers cited previously is based on double-channel operation.)

The term "parametric" comes from the fact that a variable parameter is involved. The mathematical equation describing the phenomenon will have a parameter which is periodic—that is, one of the terms has a coefficient that varies with time, commonly referred to as the parametric term.

Tuning Fork

In 1860, F. Melde described and analyzed a system in which oscillations of a string were produced parametrically by excitation from a tuning fork. Several decades later, Lord Rayleigh applied the principle to a simple L-C (inductive-capacitive) circuit pointing out that oscillations in the circuit could be parametrically excited if the value of the capacitor were made to vary periodically at twice the resonant frequency of the circuit.

To illustrate this principle, assume that a pair of hands (not described by Rayleigh) are applied to the capacitor so as to be able to push the capacitor plates together and pull them apart at will, thereby varying the circuit capacitance, as shown in Fig. 1.

Further assume that prior to any movement of the hands there is some energy stored in the circuit which is oscillating back and forth between the capacitor and inductor at the circuit's resonant frequency. If the hands suddenly pull the capacitor plates apart at the instant when the voltage across the capacitor reaches a maximum, this will reduce the capacitance and produce a corresponding increase in the voltage across the capacitor, as shown in Fig. 2.

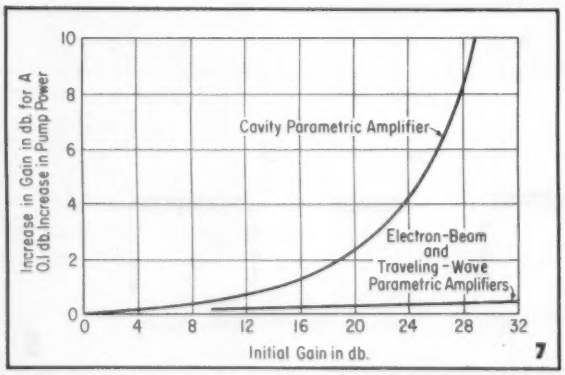
A quarter cycle later, when the voltage goes to zero, the hands quickly push the capacitor plates back to their original position. Since there is no charge on the capacitor at this instant there will be no change in its capacitance, hence no change in voltage.

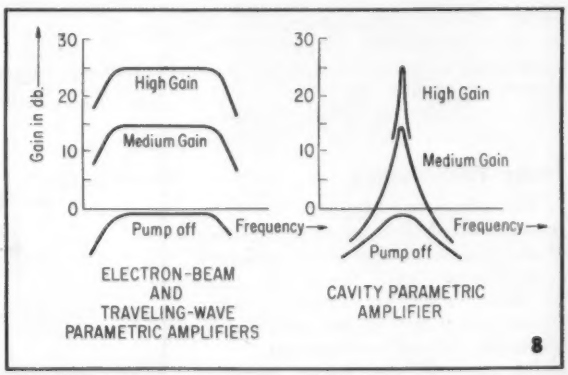
Still another quarter of a cycle later when the voltage again reaches a maximum, if the hands again quickly pull the capacitor plates apart, the voltage across the capacitor will again increase.

This increase in voltage across the capacitor, or voltage amplification, produced by the movement of the capacitor plates results from the flow of energy from the hands which are pumping the plates up and down.

In a parametric amplifier, the energy source used to perform the function of the hands in the former illustration is called the "pump." Normally this is a source of radio frequency power.

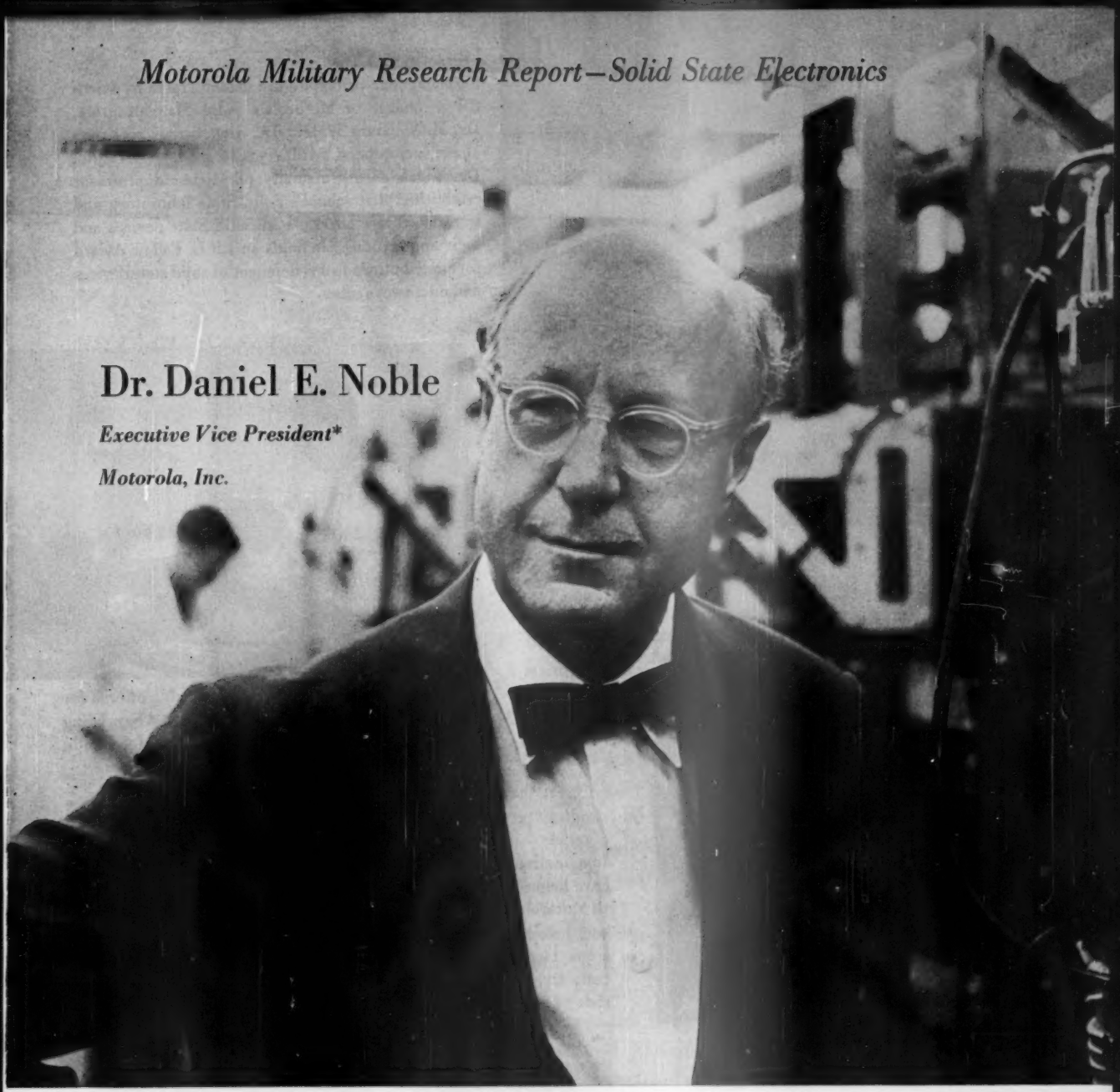
Because of the parametric principle, a beat phenomenon takes place and a


Increase in Gain in db. for A 0.1 db. Increase in Pump Power
Cavity Parametric Amplifier
Electron-Beam and Traveling-Wave Parametric Amplifiers
Initial Gain in db.
7



RELATIVE INSTABILITY of cavity type parametric amplifier gain with variations in pump power is shown at left in comparison of increase in gain from initial gain for a 0.1 db. increase in parametric amplifier pump power level. Drawing at right shows how bandwidth of electron-beam and traveling-wave type parametric amplifiers remains constant over wide frequency regardless of amplifier gain (left side), but bandwidth of cavity type goes down sharply with higher gain (right side).

Motorola Military Research Report—Solid State Electronics



Dr. Daniel E. Noble

*Executive Vice President**

Motorola, Inc.

*DR. NOBLE IS VICE PRESIDENT IN CHARGE OF THE COMMUNICATIONS AND INDUSTRIAL ELECTRONICS DIVISION, THE SEMICONDUCTOR PRODUCTS DIVISION AND THE MILITARY ELECTRONICS DIVISION OF MOTOROLA, INC.

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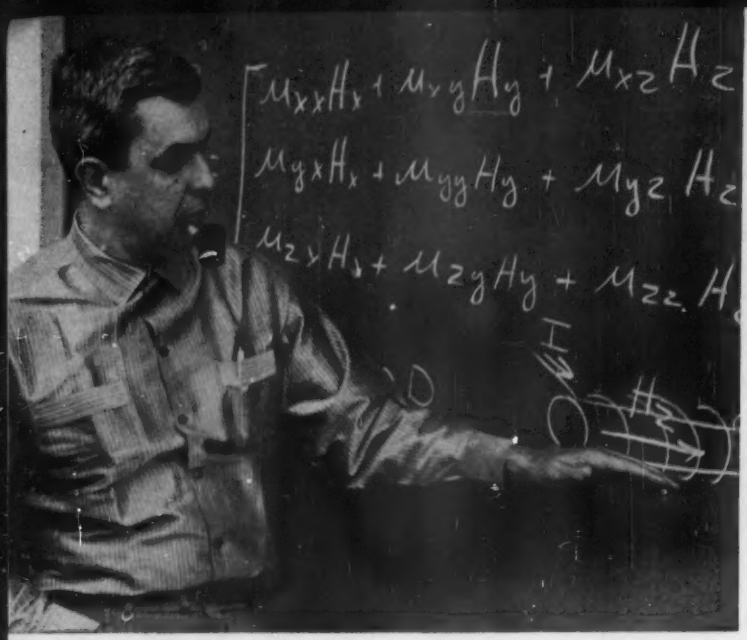
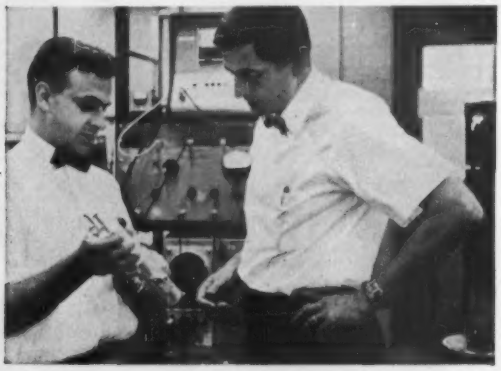


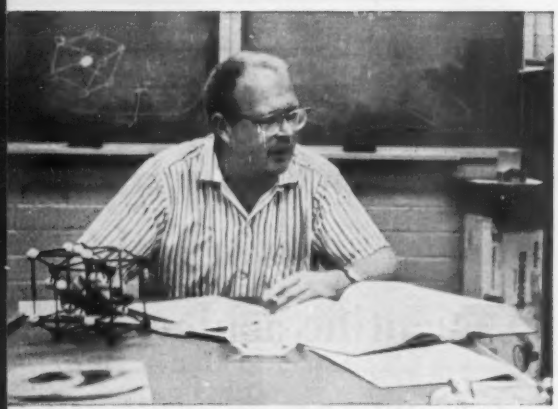
Ferrimagnetic principles are demonstrated by scientist in charge of Motorola's Solid State program, Dr. H. William Welch, Jr., director of research and development, Military Electronics Division. Dr. Welch as a University of Michigan professor established that school's Solid State laboratory and introduced new curricula in Solid State devices and their applications. He holds an I.R.E. Fellow Award for contributions to development of solid state devices and microwave tubes.

Typical of solid state materials now being offered for sale by Motorola are these ferrite rods and bars being examined by Donald L. Fresh, manager of the Solid State Materials Laboratory.

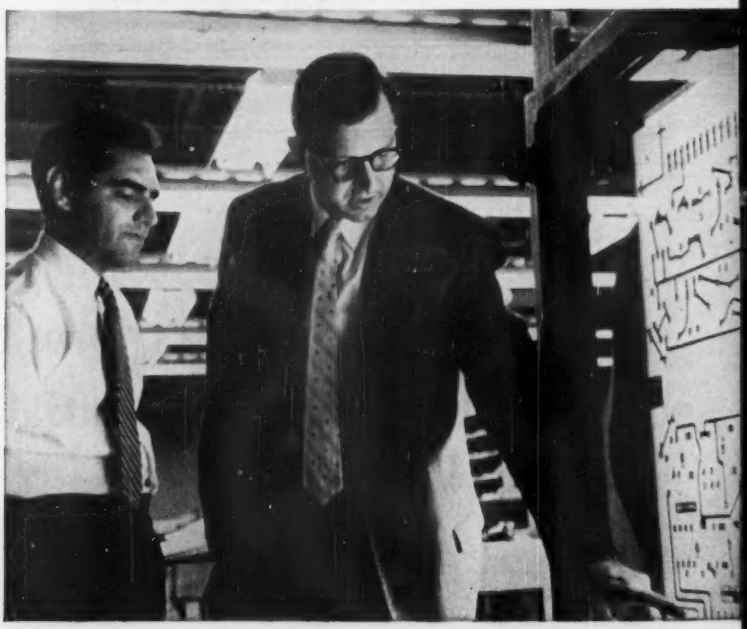
John C. Cacheris, right, manager of the Microwave Applications Laboratory, and a member of his staff inspect a parametric amplifier, one of several devices now being produced by Motorola's Solid State Dept.



Imaginative leadership plus the most modern of laboratory facilities have helped foster a creative environment that is attracting top talent to Motorola. Here, Dr. Arthur L. Aden, associate director of research and development for Motorola's Military Electronics Division, shows a new member of his staff equipment for photographing printed circuits. Dr. Aden welcomes inquiries from qualified engineers and physicists who would like to join his department.



James R. Black, manager of Motorola Microelectronics Laboratory, heads work which leads toward the mass production of economical microelectronic components so small that several would fit on the period that ends this sentence.



How Solid State Electronics is shaping the future

MILITARY ELECTRONICS—industry as well—is being radically changed by rapid advances in solid state technology. Predicted for the near future are computers small enough to fit in the palm of a hand, receivers that will detect the weakest signals from distant satellites.

Motorola's highly experienced Solid State Department, in close cooperation with the Semiconductor Products Division, is advancing the state of the art on several fronts, one of the most promising of which is microelectronics.

By making use of crystalline functional circuit elements created in volume quantities by surface etching or film deposition methods, Motorola researchers anticipate they will soon be able to design equipment with component densities of tens of millions per cubic foot.

This high density will result in a great reduction in systems and computer size coupled with a significant increase in reliability, and it will lead to the development of self organizing computers for such complex tasks as the solution of military logistics problems and space guidance.

In microelectronics and in other areas, Motorola scientists, including those of the Semiconductor Division, are investigating the ferroelectrical, ferrimagnetic, piezoelectrical and pyroelectrical characteristics of monocrystalline and polycrystalline solids. New materials possessing these useful characteristics are created and produced in the Materials Laboratory. Typical applications: newly developed ferroelectrical or piezoelectrical materials to be used in transducers for submarine detection.

At present, the Applications Laboratory is making extensive use of ferrites and semiconductors in the development of broad lines of isolators, circulators and parametric amplifiers. The latter device has already demonstrated its worth in satellite-tracking radars, IGY research receivers, uhf television receivers and radio. In the study and design stage are new and advanced ferrimagnetic devices such as microwave switches, ferrimagnetic limiters and semiconductor switches.

Still another research frontier where striking preliminary results have been achieved is a low-voltage facsimile paper for the transmission of teletype and other information. Applications in the fields of combat surveillance, logistics control and other important military programs are foreseen.

Military Electronics Division's expanding capability in solid state electronics is described in a new booklet entitled: "Solid State Frontiers at Motorola." *Request your copy from Technical Data Service, Motorola, Inc., Military Electronics Division, 8201 East McDowell Road, Scottsdale, Arizona.*

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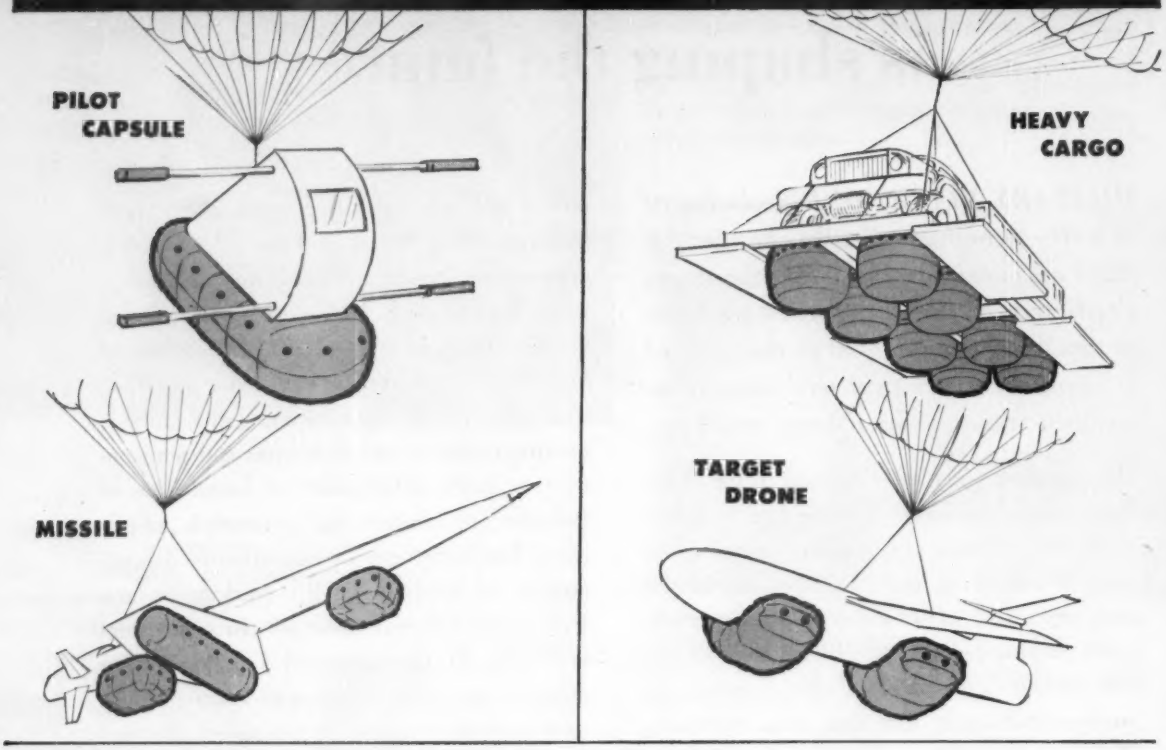

Solve New Missile and Capsule Recovery Problems

Air Cruisers has nearly a decade of experience in the development, testing and production of pneumatic recovery systems. Beginning with aerial cargo recovery, the company expanded its activities to include deceleration systems for various missile and target drone applications.

Other Air Cruisers system designs include recovery of missile nose cones and component parts, and pilot capsule recovery which enables the crew to land safely in the sealed capsule.

Air Cruisers' recovery systems consist of inflatable deceleration and/or flotation bags specially designed to meet all requirements:

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third signal is generated whose frequency is equal to the difference between the pump frequency and the amplifying frequency. In the conventional parametric amplifier, where the input and output signals have the same frequency, the third signal is an unused byproduct and hence is called the idler frequency.

For regenerative amplification, the pump frequency must be higher than either the amplifying or idler frequencies. In applications where single-channel operation is required, it is important that the pump frequency be as high as possible to minimize amplifier noise.

For single-channel operation at room temperature, the minimum theoretical noise figure is equal to the ratio of the pump frequency to the idler frequency.

For double-channel operation, or for operation where the noise sources are below room temperature, the minimum theoretical noise figure is not restricted by this frequency ratio.

Three different types of parametric amplifiers have been built to date, using semiconductor diodes, ferrites and electron beams. Although the ferrite amplifier may ultimately prove to have certain advantages over the diodes and electron-beam types, it is considerably less far advanced than the former and there are too many unknowns to be able to predict its future value. For this reason, the discussion that follows will consider only the semiconductor and electron beam types of parametric amplifier.

One of the characteristics of a semiconductor diode is the fact that its capacitance varies as a function of the voltage impressed across its junction. If a variable source of voltage is connected across a P-N junction diode so that the positive terminal is attached to the N-type material and the negative terminal to the P-type material, the electrons in the N-type material and the holes in the P-type material are repelled, producing a thin depletion layer near the region of the junction.

If the applied voltage is increased, the depletion layer expands. If the polarity of the applied voltage is reversed and the voltage is increased, the depletion layer contracts. Thus the depletion layer resembles the space between the plates of the capacitor in the previous illustration.

As the depletion layer widens, the diode capacitance decreases. When the depletion layer contracts, the capacitance increases. If the voltage applied across the semiconductor diode oscillates at microwave frequencies, the capacitance of the diode will vary also at microwave frequencies. This provides the necessary pumping action for microwave parametric excitation and therefore for microwave amplification.

There are two fundamental classes of parametric amplifiers which use diodes: cavity-type and traveling-wave type.

• **Cavity type** amplifier operation can be represented by two resonant cavities, coupled in series with a variable capacitor, as illustrated in Fig. 3. (Diagram is simplified and does not show pump voltage impressed across diode to produce variable capacitance.) The pump voltage impressed across diode the two cavity resonant frequencies as f_1 and f_2.

An input signal at f_1 is fed into the cavity at the left, which is resonant to that frequency, and an amplified version of the signal is extracted from output of the same cavity. An idler signal at f_2 is generated in the second cavity and can be extracted from it if desired. For single-channel operation, the idler signal is not extracted and if f_1 and f_2 are sufficiently different, the first cavity provides the filtering needed for both the input and output. Often in the case of double-channel operation, f_1 and f_2 are so nearly equal that only one resonant cavity is needed and signals at both the amplifying and idler frequencies then appear simultaneously within the single cavity.

Under these conditions the input and output couplings will pass both the amplifying and idler frequency channels.

Because of the parametric excitation, the variable capacitance and the idler cavity appear to couple a negative conductance into the input cavity, or tank. The gain therefore is expressed by the equation for regenerative amplifiers and at resonance can be written as follows:

$$\text{Power gain} = \frac{K_1}{(G_T - G)^2}$$

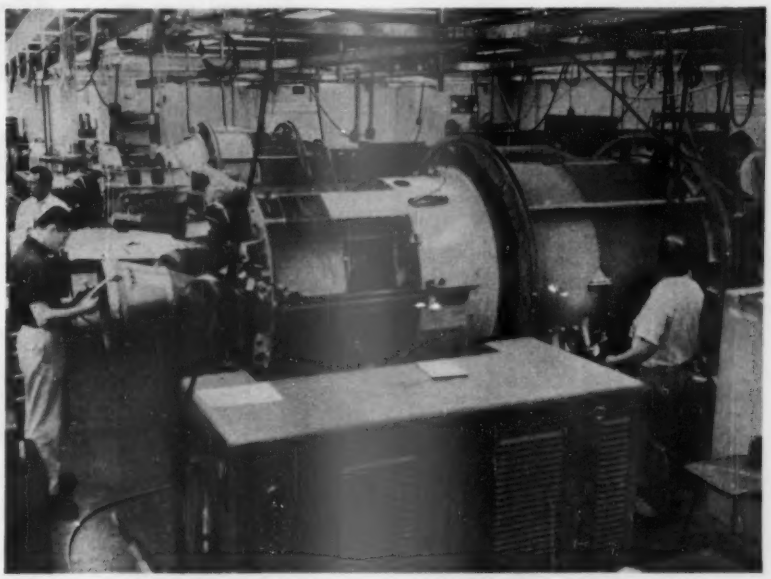
Where:

K_1 is a constant which depends upon input and output loading and has the dimensions of conductance squared.

G_T is the summation of all the positive conductances loading input cavity.

G is the magnitude of the negative conductance which is coupled into the input cavity. This is proportional to the square of the total variation in capacitance. In a semiconductor diode, capacitance variation is approximately proportional to the square root of pump power. Hence G is approximately proportional to pump power.

• **Traveling-wave** parametric amplifier consists of a transmission line which is periodically loaded with semiconductor diodes. Across each diode is fed a large pumping voltage which produces a time-varying capacitance, as shown in Fig. 4. If the propagation constants of the amplifier are suitably chosen, so the sum of the constants for the input and idler frequencies equals that for the pump frequency plus the term $\frac{2n\pi}{d}$, where "n" is an integer including zero and "d" is the distance between adjacent diodes, then the diodes appear to couple negative conductances into the transmission line at periodic intervals along the line. Under these cir-



Avionics Tested on Agena Satellite

Agena satellites used in Advanced Research Projects Agency Discoverer program undergo checkout and modification of avionic equipment at Lockheed Missiles and Space Division, Palo Alto, Calif. Bell Hustler rocket engine powers the Agena, which is the second stage of the Thor Hustler vehicle.

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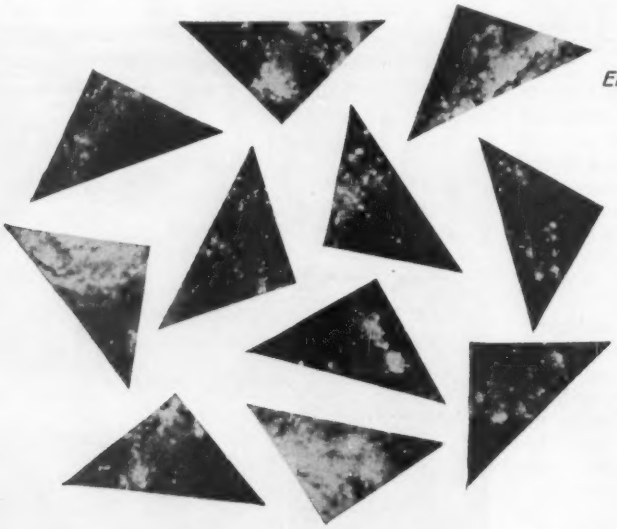

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cumstances the power gain is expressed by the following:

Power Gain = Cosh^2 a L

Where "a" is proportional to the capacitance variation and therefore to the square root of pump power.

"L" is the length of the traveling wave section of the amplifier.

The motion of individual electrons in an electron beam can be pumped parametrically and made to grow. This is the principle upon which the electron-beam parametric amplifier operates.

This process can be visualized by means of a mechanical analog of a single electron in the beam, consisting of a pendulum bob moving in simple harmonic motion. Assume that the pendulum bob is charged positively and that it swings across a uniform electric field whose magnitude can be varied at will.

If the field is suddenly turned on whenever the pendulum reaches either end of its travel and suddenly turned off when the pendulum swings through the center equilibrium position, the motion of the pendulum will be increased or amplified by the pumping action of the electric field.

Oscillating Electron

When an electron in a beam is removed from its equilibrium position, it will oscillate around that position in such a way that its component of motion in any plane containing the beam axis is simple harmonic motion. This is true for both transverse waves of electron motion, such as cyclotron waves, and longitudinal waves, such as space charge waves.

In this sense, the electron is analogous to the pendulum bob and since the electron carries a charge it is analogous to the charged pendulum described. Similarly a suitable time-varying electric field is also capable of pumping or amplifying the motion of the electron. Since the equilibrium position of the electron travels with the beam, the pumping field must also, in effect, travel with the beam. A traveling electric field of the proper kind can parametrically amplify the wave motion, for either transverse or longitudinal waves, of all the individual electrons in a beam.

This type of parametric amplification is possible for both the so-called fast beam waves and the slow beam waves, a fact of great importance in achieving low-noise amplification. More conventional microwave tubes, such as the traveling-wave tube and klystron, amplify by virtue of interaction of the field with a slow beam wave.

It has been established theoretically that after the beam emerges from the electron gun, the noise present in the slow wave cannot be completely removed or canceled whereas complete

Now you can record test data on-the-spot. In both lab and field you get accuracies equal to or better than big, rack mounted units. Just pick up and move a multi-channel (up to 14) PI recorder/reproducer as you would any other item of test equipment.

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How did PI put precision in a small package? By combining transistorized electronics with unique stacked reel tape magazines. PI recorders use standard tapes and heads, are compatible in every way with standard recording practices and other recording equipment.

KEY SPECIFICATIONS (Model PS-207 Series unit)

FM SYSTEM: Frequency response ±1/2 db 0-10 kc, S/N ratio 43 db, better than 1.5% total harmonic distortion, less than 2% drift 40° to 120° F., linearity 1%.
DIRECT SYSTEM: Response ±3 db 50-100,000 cps.
POWER: 115 vac, 48-62 cps or 24 vdc.
FLUTTER: Less than 0.1% rms dc to 300 cps or .5% peak-to-peak at 30 ips.
PS-207 shown contains electronics for 7 record/reproduce channels.

After you note these key specs, may we suggest you call your PI representative to arrange a demonstration? If you are uncertain who he is, please write direct. Address Dept. O-511.

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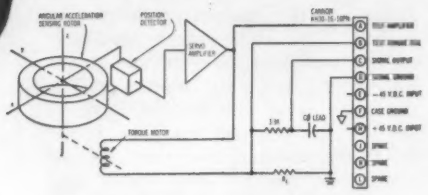
Chief applications for this unique force balance angular accelerometer are closing the servo loop on ground launching equipment for missiles and detecting the roll, pitch and yaw accelerations of missiles once they are airborne. In the latter application, the Model 4525 can replace some gyros and supplement others.



Operational diagram of Donner's new Model 4525 Angular Accelerometer.

Donner's rugged new angular accelerometer weighs only 2 pounds.

The Specs

RANGES AVAILABLE
From ±1 radian/sec² to ±50 rad/sec² to any intermediate range.
FREQUENCY RESPONSES
±1 rad/sec² 30 cps natural frequency (90° lag)
±10 rad/sec² 100 cps natural frequency (90° lag)
OUTPUT, FULL SCALE
±20 volts across a 12,500 ohm load
RESOLUTION 0.01% full scale or better
LINEARITY 0.1% full scale
HYSTERESIS Less than 0.01% full scale
DAMPING 0.6 ± 0.1 of critical
SIZE 3.7" diameter x 3.7" high
WEIGHT 2 pounds

The mechanically rugged and electronically rigid Model 4525 is one more basic technical contribution from an engineering team specializing in inertial systems interlocking time, acceleration, velocity, and other dynamic inputs.

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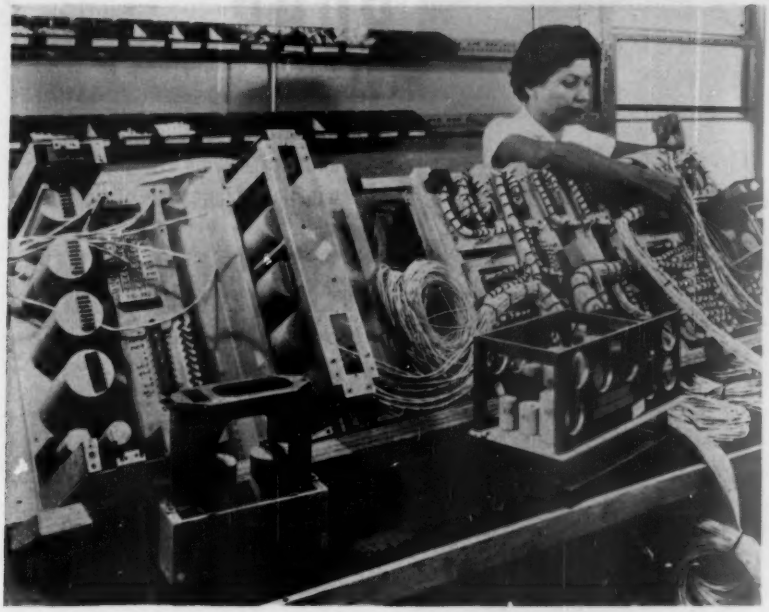

Mockups Facilitate Computer Production

Mockups of computer components are used by Librascope, Inc., a subsidiary of General Precision Equipment Corp., to facilitate development of efficient production methods. Mockups are usually constructed of wood to follow in exact detail the dimensions and configurations of equipment which must be fitted to conform to specified cabinet dimensions and configurations. Worker is preparing cable harness on a mockup board which contains wooden subassemblies and terminal blocks in proper relationship to final equipment configuration. Detailed wooden subassemblies are on bench in foreground.

noise removal is theoretically possible for the fast waves.

There already is experimental confirmation that the effective beam temperature of a fast cyclotron wave can be reduced to below 25K.

Basic configuration of an electron beam parametric amplifier is shown in Fig. 5. The three sections of helix represent the input coupler, amplifying section where pump power is coupled into the beam, and the output coupler. The input coupler serves two functions: to couple out of the beam the entering fast-wave components of beam noise, thus cooling the beam, and simultaneously to modulate the beam with a new fast wave corresponding to the input-signal.

This type tube has more in common with the traveling-wave diode amplifier than with the cavity type diode amplifier. For example, both the traveling-wave diode amplifier and electron beam parametric amplifier can be relatively wide band and the relationship between gain and pump power is the same for both.

(For details on electron-beam parametric amplifier developed by Zenith, see AVIATION WEEK, Sept. 1, 1958, p. 64. For details on Bell Telephone Laboratories diode amplifier, see AVIATION WEEK, Aug. 4, 1958, p. 69.)

The general characteristic most sought in parametric amplifiers has been low-noise performance. A graphic presentation of excess noise temperatures achieved to date for both diode and electron-beam parametric amplifiers is shown in Fig. 6.

However, there are other factors to be considered, depending upon the end application. For example, the cavity type diode amplifier is more rugged and less expensive than the traveling-wave type or electron-beam parametric amplifier.

Another advantage of the cavity type is that it requires relatively little pump power.

The main disadvantage of the cavity type diode parametric amplifier appears to be its inherent instability. If pump power changes very slightly the amplifier's gain can change drastically.

This is illustrated in Fig. 7 which is based on calculated theoretical performance.

For example, if the amplifier has an initial gain of 25 db. and pump power changes by only 0.1 db., the cavity type parametric amplifier will experience a 6 db. increase in gain compared with less than 0.5 db. for either a traveling-wave diode type or electron-beam parametric amplifier.

The cavity type is by nature com-

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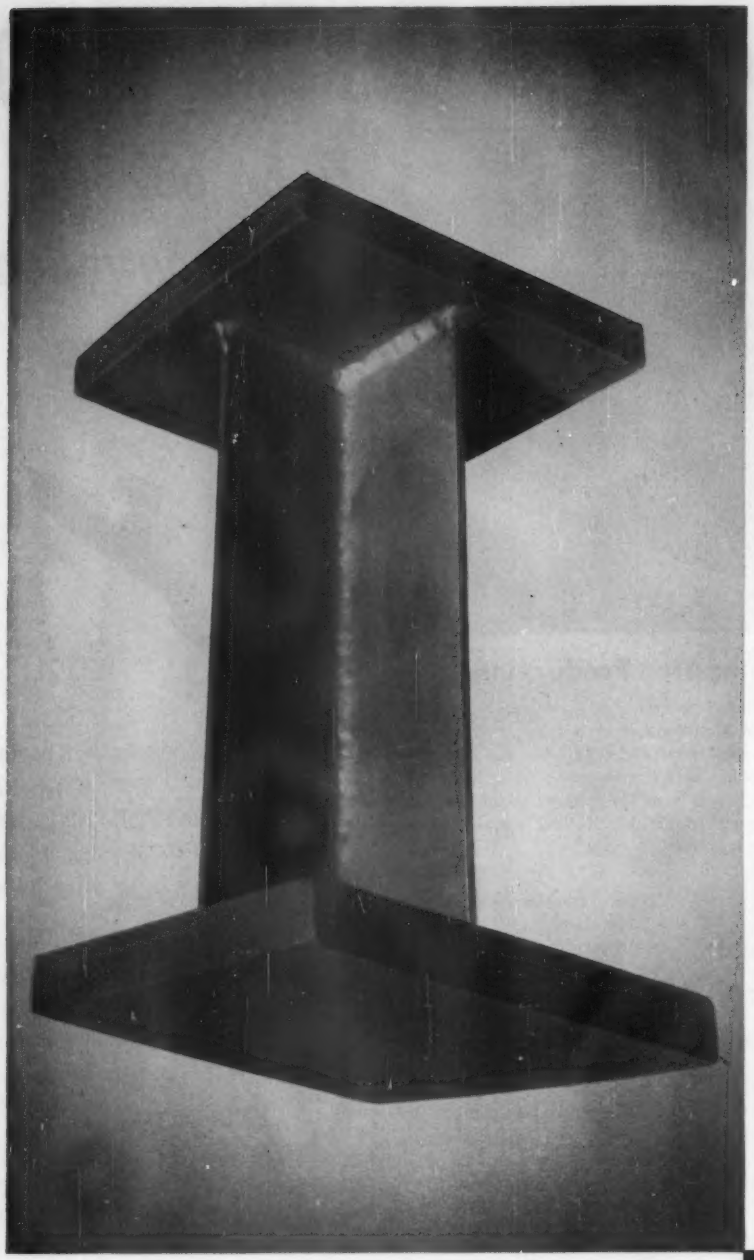

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Test sample weldment of René 41 high-nickel alloy for research purposes.

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Space Probe Radar

Washington--Powerful radar with a 1,000 ft. diameter antenna will be constructed in Puerto Rico for the study of ionization effects of ballistic missile nose cone passage through the upper atmosphere during mid-course flight, for measurement of electron densities and temperatures in space and for radar mapping of the moon and nearby planets, according to the Advanced Research Projects Agency. Construction of the radar was predicted by Aviation Week last Nov. 24 (p. 23). The $4.5 million facility will be constructed by Cornell University under Air Force contract. Novel antenna will consist of parabolic shaped hole scooped in the ground, covered with wire mesh. Radar will operate at 400 mc.

pletely reciprocal and for best performance requires the use of a circulator. The traveling-wave type can be designed to be non-reciprocal. In theory, it should be capable of short-circuit stability but because of reflections within the transmission line, this is difficult to achieve in practice.

The electron-beam type is by nature non-reciprocal because a signal applied to the output terminal can not be carried upstream by the beam to appear at the input terminal. In a sense the amplifier provides its own built-in circulator and consequently is always short-circuit stable.

Bandwidth

Cavity type-amplifiers are inherently narrow band but special techniques can be used to increase the bandwidth. Preliminary experiments at Bell Telephone Laboratories indicate that a 40% bandwidth at 500 mc. is possible in a practical amplifier. When these techniques are not used, the bandwidth of the cavity type amplifier is a function of gain, as shown in Fig. 8.

Theory indicates that the bandwidth of traveling-wave type and electron-beam type parametric amplifiers should not be a function of gain, but practice does not bear out theory in the case of the traveling-wave type. Bandwidths of 40 mc. have been achieved by Zenith in its electron-beam amplifier operating at UHF frequencies. Analysis indicates this figure can be tripled at center frequencies below 1,300 mc., with bandwidths of 10% possible at higher frequencies.

Insofar as upper frequency limit is concerned, diode type parametric amplifiers have been operated at 10,000 mc. (X-band) with good low-noise performance at this frequency. The electron-beam amplifier has been operated at frequencies as high as 4,000 mc., and Zenith reports it is planning a de-

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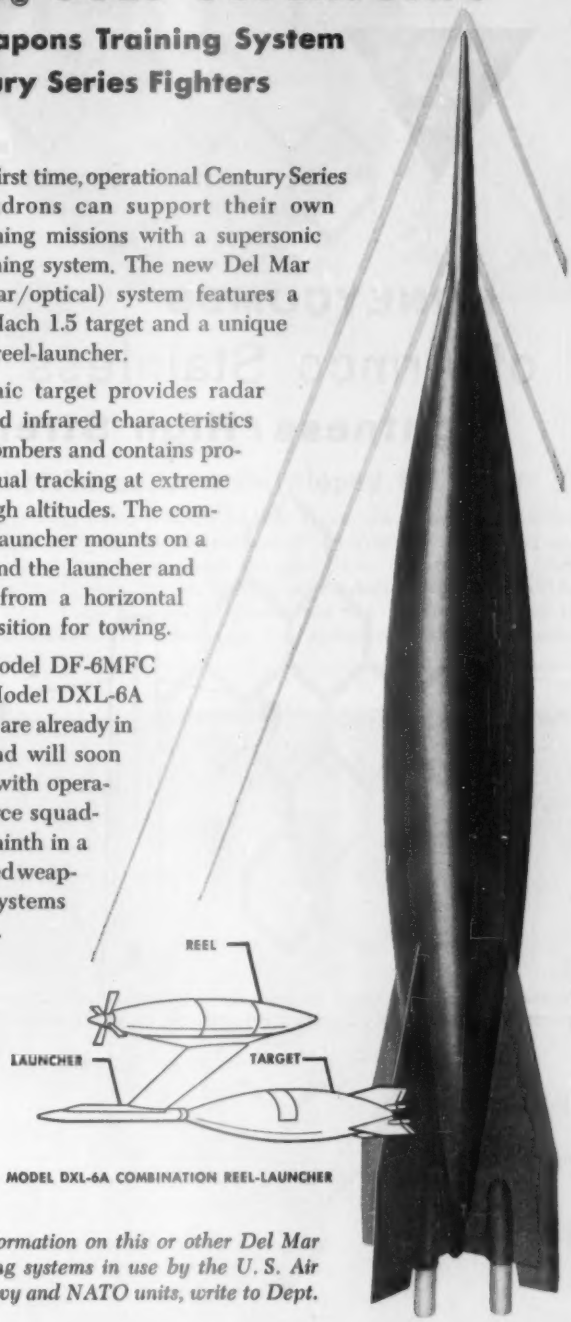
These new Model DF-6MFC targets and Model DXL-6A reel-launchers are already in production and will soon be in service with operational Air Force squadrons...as the ninth in a line of advanced weapons training systems from Del Mar.



MODEL DXL-6A COMBINATION REEL-LAUNCHER

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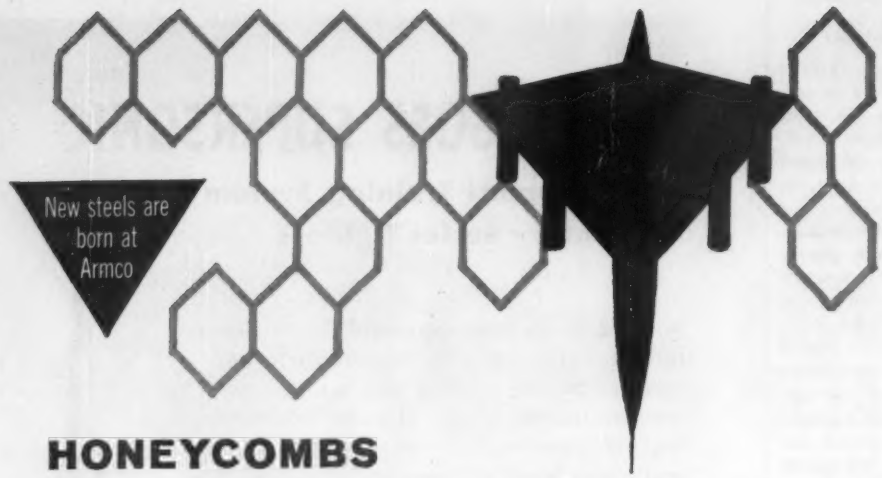

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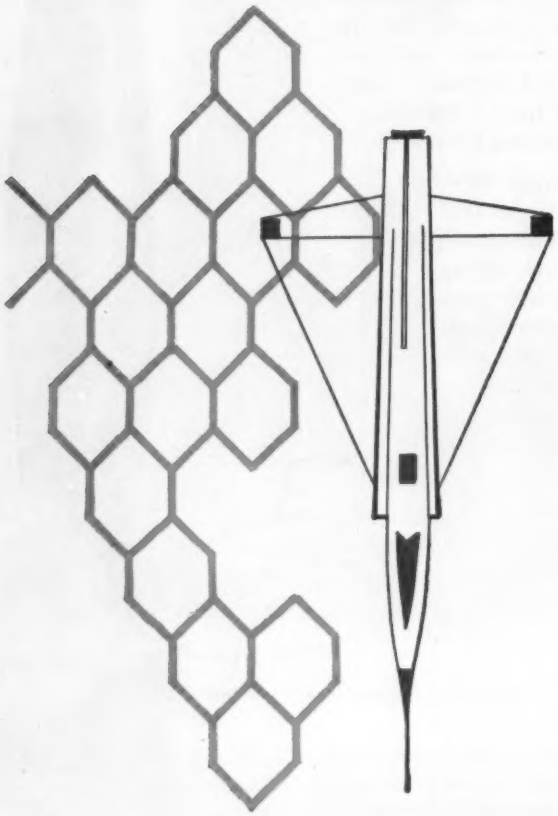

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vice for X-band operation. However, the problems of fabricating an electron-beam parametric amplifier to the small dimensions required for extremely high frequencies suggests that the practical upper limit may be around 10,000 mc.

Expansions, Changes In Avionics Industry

Convair Division of General Dynamics Corp. has set up new electronics department at its San Diego Division "to facilitate further orderly expansion" in this field. R. E. Honer, former assistant chief engineer for electronics, has been named manager of new department. Other appointments include: W. E. L. Boyce, program management; E. C. Oertel, engineering; E. W. Carlson; manufacturing; W. R. Rauth, customer requirements; W. S. Stroud, administration. Department currently has 730 employes, 300,000 sq. ft. of space in Convair's Plant 1.

Other recently announced changes, expansions and acquisitions in the avionics field include:

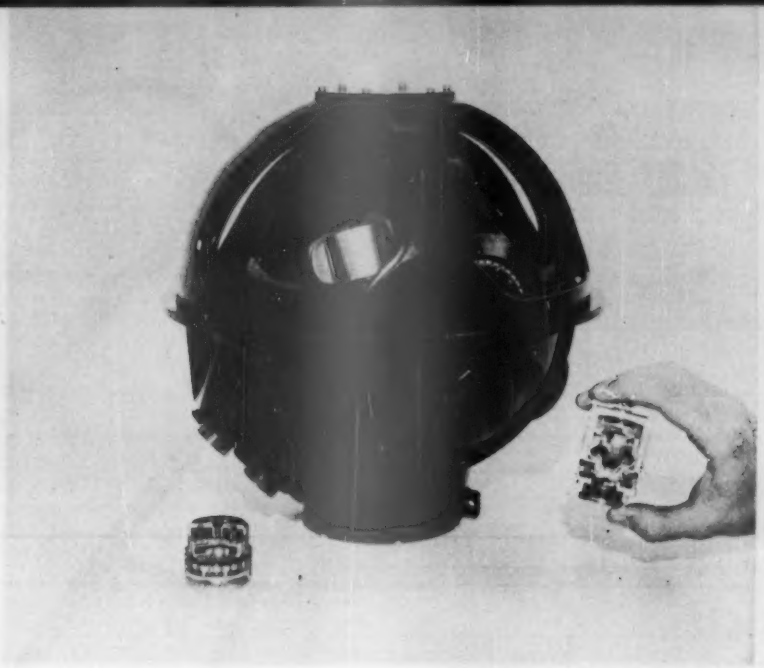
• **International Electronics Corp.** (INTEC), Mineola, N. Y., will acquire **Westbury Electronics, Inc.,** Westbury, N. Y., maker of video and magnetic products. Combined organization will have gross sales of about $3 million in 1959. Henry Abajian, president of new acquisition, becomes a vice president of INTEC.

• **Librascope, Inc.,** subsidiary of General Precision Equipment Corp., has established new applied research department to investigate new concepts in solid state physics. Wayne Blackburn has been named director.

• **Telecomputing Corp.,** Los Angeles, has formed new Electronic Systems Division through integration of its Brubaker Electronics and Nuclear Instruments Divisions. Berne N. Fisher, former general manager of Brubaker, heads new division.

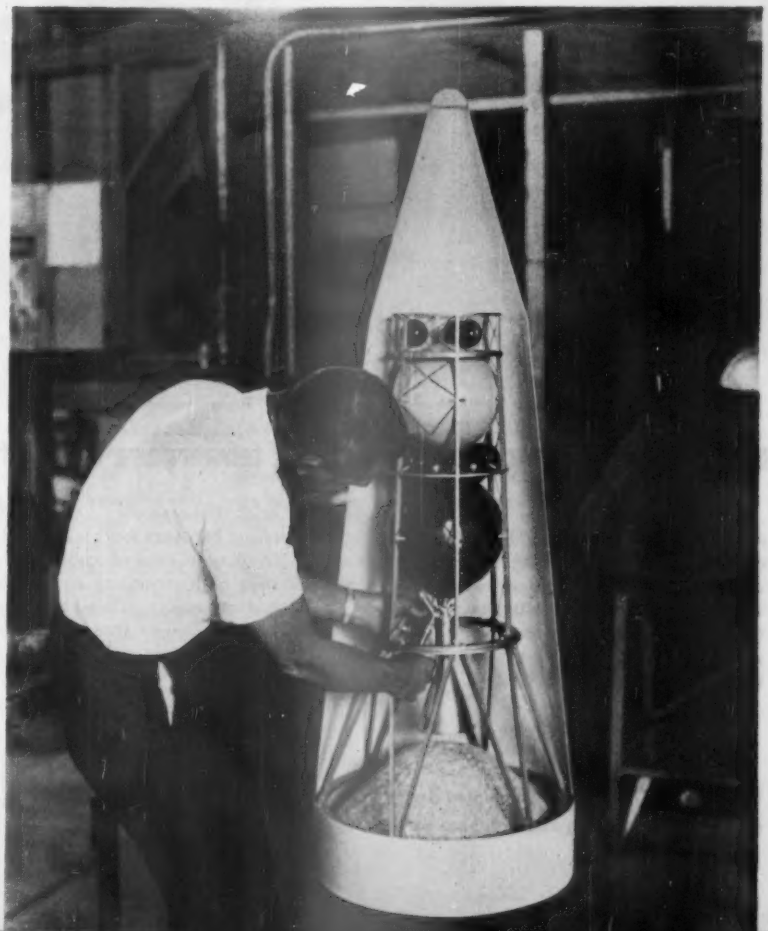
• **Hazeltine Research Corp.,** a subsidiary of Hazeltine Corp., is opening new research and development center in Plainview, N. Y. Jennings B. Down has been named president and Dr. R. K. Hellmann, vice president of parent company, is operating vice president and technical director of new operation.

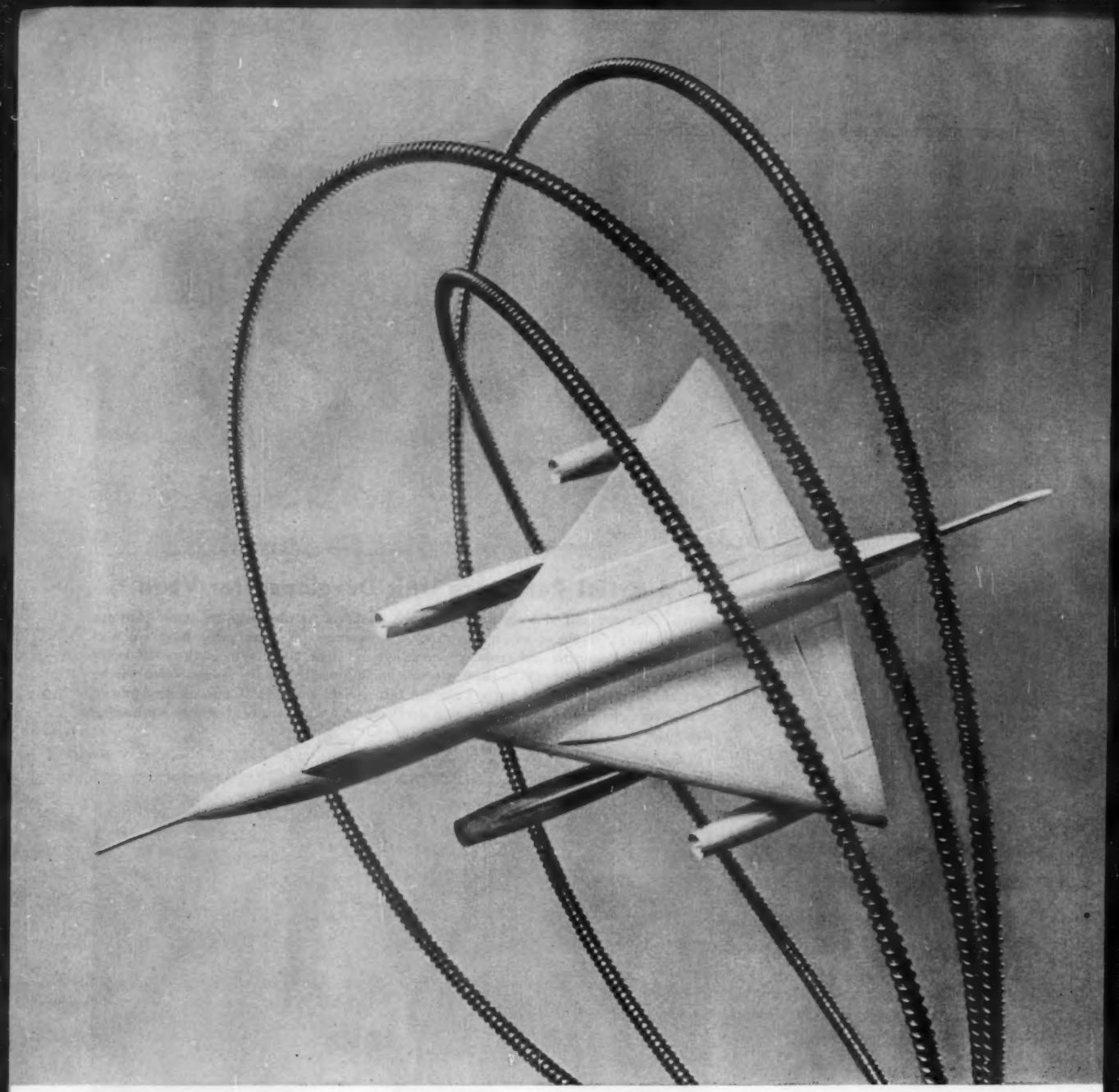
• **Autonetics Division** of North American Aviation has established four separate products divisions: Armament and Flight Controls, under C. A. Wolf; Computers and Data Systems, under N. F. Parker; Inertial Navigation, under S. F. Eyestone; and Industrial Products, with E. A. Holmes, III, as operations manager. Each operations manager re-



Inertial Reference Unit Developed for Vega

Inertial reference unit of Vega rocket vehicle's guidance system comprises stable platform (center, above), inside of which are three accelerometers and three gyroscopes. Cutaway models of accelerometer and gyroscope are at left and right, above. One-sixth model below shows configuration of 6,000-lb. thrust storable liquid propellant engine system which will be used as last stage of Vega. Large tanks are for oxidizer and fuel. California Institute of Technology's Jet Propulsion Laboratory is developing Vega systems for National Aeronautics and Space Administration.





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ports to John R. Moore, Autonetics general manager, and will be responsible for product development, manufacturing and marketing.

• **Lerco Electronics, Inc.,** Los Angeles, has acquired control of **Micro Gee Products, Inc.** New acquisition will continue to operate as separate subsidiary, with founders B. W. McFadden and David S. York remaining as vice presidents in charge of technical sales and mechanical design, respectively. Walter E. Peterson has been named president of new subsidiary.

• **Avien, Inc.,** has formed new Department of Undersea Technology, to develop instrumentation and propulsion systems for underseas applications. W. M. Rand heads new department.

• **Sylvania** will construct a 32,000 sq. ft. plant in Santa Cruz, Calif., for manufacture of computer components, with completion scheduled for early next year.

• **Ling-Altec Electronics** will construct new 65,000 sq. ft. manufacturing building at company's Anaheim, Calif., facility. Approximately 450 people will be employed in new facility.

• **Pacific Mercury Electronics,** Sepulveda, Calif., has purchased controlling interest in **National Automation Corp.**

FILTER CENTER

▶ **Transistors to Shed Cases**—Bell Telephone Laboratories reportedly has made good progress toward developing a technique for protecting transistor crystals from contamination without the need for a relatively large, hermetically sealed metal can. One promising approach is to use thermal oxidation of silicon crystal for encapsulation. Ironically, when the transistor was first developed it was one of the smallest components used in an electronic circuit. But with recent advances in deposited resistors, capacitors and conductors for microcircuitry, the transistor has become one of the largest components.

▶ **Collins Radio Co.** received an order for more than $231,000 worth of doppler radar navigation systems for installation on Trans-Canada Air Lines' Douglas DC-8s. Six FM-CW doppler systems are to be installed and five will be spares. TCA also has an option to purchase 10 additional systems from Collins. Deliveries begin January, 1960.

▶ **Two prototypes** of AN/ARC-54 FM receiver-transmitter and two prototypes of AN/ARR-49 have been delivered to U.S. Army Signal Corps by Collins Radio Co. Development contract for the equipment totals approximately $2.4 million, calls for delivery of 37 prototype models of each equipment in 1961. ARC-54 use a double-conversion superheterodyne type transmitter-receiver, operating on 800 channels covering 30 to 69.95 mc. with 50 kc. spacing and any 50 channels can be preset. ARR-49 is the receiver unit.

▶ **Nortronics Division** of Northrop Corp. will begin construction of an underground research and development laboratory in Anaheim, Calif., for advanced engineering studies in the field of passive countermeasures rockets. Underground complex will include small research and development laboratory, static test firing range, and magazine for storing detonators and nonexplosive propellants. Approximately 30 technical personnel will work in the complex.

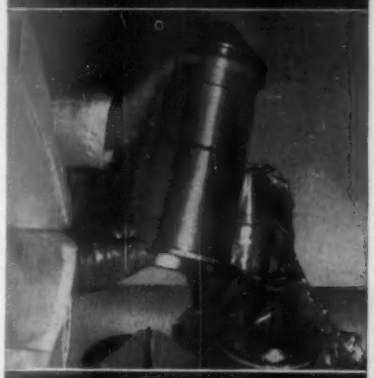
▶ **Radiation, Inc.'s** Florida Division has been awarded a contract for approximately $400,000 by Northrop Corp.'s Norair Division to design, build and test an advanced flight test data acquisition and data processing system in connection with the Northrop N-156F flight program. Equipment will include an airborne automatic digital data acquisition system for rapid conversion of airborne input analog data for recording on magnetic tape and subsequent computer operations.

Significant new developments in semiconductor and electron beam amplifiers and display devices reported during recent National Conference on Electron Devices in Washington, include the following:

▶ **Circlotron Amplifier**—New type amplifier, called the Circlotron, which combines principles of the magnetron and traveling-wave-tube, was reported by J. Kline of Sanders Associates, Nashua, N. H. Experimental tubes built to date have yielded gains greater than 20 db. at X-band over a 5% bandwidth with peak power outputs of one to 10 kw. Bandwidths of 13% have been achieved at lower gains. Tube has an efficiency of 30% to 60%, Kline reported. The Circlotron employs a one-port, re-entrant, magnetron structure which obtains its high gain by internal regenerative feedback and its wide bandwidth by heavy load damping. Ferrite circulator is used to separate input and output signals.

▶ **Super-Power Klystrons**—Four-cavity klystron tube capable of delivering 20 megawatts with efficiency of 40% with gain of about 40 db. was described by four French scientists from Compagnie Generale de Telegraphie Sans Fils. The

from a STERILE room



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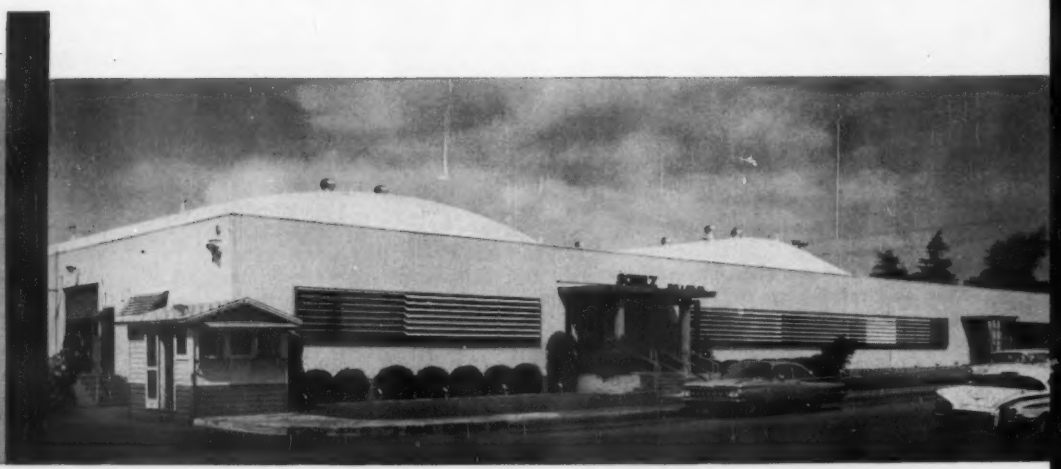

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scientists are P. Cahour, G. Dube, G. Guilbaud and P. Palluel.

▶ **Wideband Super-Power Klystrons**—L-band pulsed klystron, with bandwidth of approximately 15% and power output in the megawatt range, has been developed by Varian Associates. Development was reported by W. Beaver, G. Caryotakis, G. Huffman and N. Taylor.

▶ **Selective-Erasure Storage Tube**—New direct-view halftone storage tube, which permits rapid erasure of one or more of the smallest written elements without erasing entire display as in previous storage tubes, was reported by N. H. Lehrer, of Hughes Research Laboratories, Culver City, Calif. New tube also permits non-storage writing, i.e. the presentation of information on the tube face without disturbing written or erased areas of the storage target. Tube employs special storage target which exhibits dual charging phenomena. Depending upon the incident beam energy, the storage surface can be positively charged by secondary emission or it can be charged negatively by bombardment induced conductivity. At lower beam energies, the secondary emission effect predominates, while at higher energies the induced conductivity predominates, Lehrer reported.

▶ **Microwave Transistor**—Germanium P-N-P mesa transistor with diffused base and alloyed emitter developed by Bell Telephone Laboratories can be operated at 3,000 mc. at an oscillator or amplifier, or can be used in feedback amplifiers requiring bandwidths of 500 mc., according to a report by R. E. Davis, C. A. Bittmann, R. J. Gnaedinger.

▶ **New Diode for Parametric Amplifiers**—Silver-bonded diode, which is superior to gold-bonded diodes for use in parametric amplifiers, was described in a report by three Japanese scientists, S. Kita, K. Sugiyama and T. Ikajima, of the Nippon Telegraph and Telephone Public Corp., Tokyo. Scientists reported that new silver bonded diodes have been used to construct a parametric amplifier for operation at 6,000 mc. which exhibits bandwidth of 40 mc., gain of 20 db. and a noise figure of about 5 db.

▶ **Hypersensitive Silicon Capacitor**—Hypersensitive voltage-variable silicon capacitor having a range of 10:1 variation in capacitance for a 10:1 change in voltage was described by H. D. Frazier, of Pacific Semiconductors, Inc., Culver City, Calif. New units have Q-values greater than 50 at frequency of 50 mc. and a maximum capacitance of 20 Mfd. to 1,000 Mfd.

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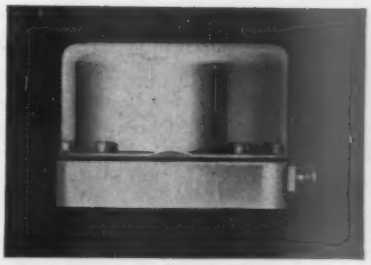

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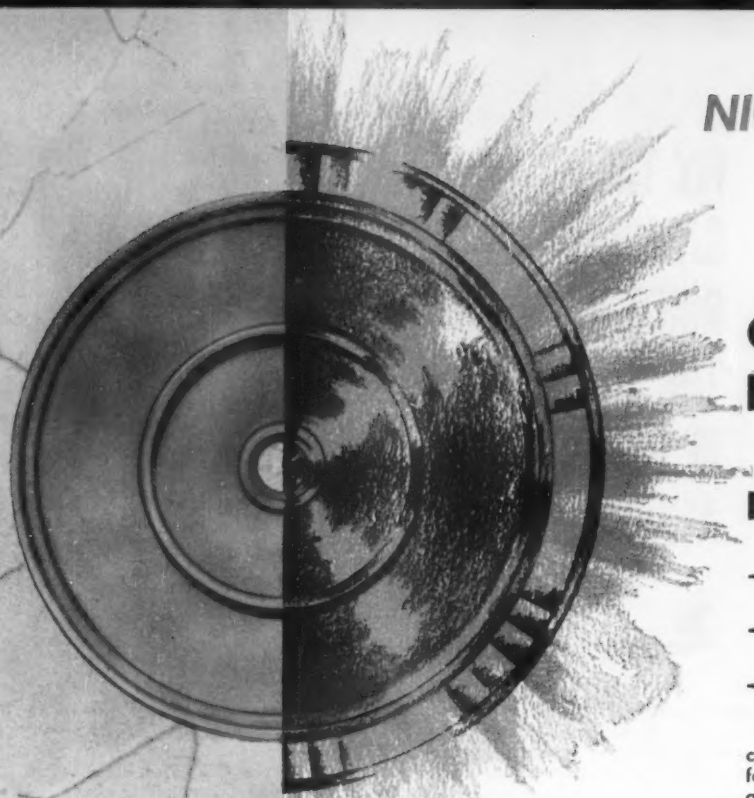

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Typical Mechanical Properties

TENSILE PROPERTIES:	Room Temp.	1400° F
Ultimate Strength, psi	200,000	145,000
.2% Yield Strength, psi	150,000	125,000
.02% Yield Strength, psi	135,000	110,000
Elongation (% in 2")	15	18
Reduction in Area, %	18	20

STRESS RUPTURE:	Combination Smooth and Notch Bar	Smooth Bar
Temperature, ° F	1350	1650
Stress, psi	85,000	25,000
Life, Hours	100	50
Elongation, %	12	12
Reduction in Area, %	14	14

Guaranteed Minimum Mechanical Properties

TENSILE PROPERTIES:	Room Temp.	1400° F
Ultimate Strength, psi	180,000	135,000
.2% Yield Strength, psi	132,000	115,000
.02% Yield Strength, psi	120,000	100,000
Elongation (% in 2")	12	13
Reduction in Area, %	14	18

STRESS RUPTURE:	Combination Smooth and Notch Bar	Smooth Bar
Temperature, ° F	1350	1650
Stress, psi	85,000	25,000
Life, Hours	40	25
Elongation, %	8	10
Reduction in Area, %	10	12

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Job Survey Cites Administration Apathy

Every few months, trade and technical magazines cry about an engineer/scientist shortage that doesn't exist. Three years ago we conducted a comprehensive, nation-wide survey of engineer recruitment practices. Results, published by AVIATION WEEK Jan. 21, 1957 (p. 97), proved the shortage was in personnel practices, not in available engineers.

Management displayed marked interest in this survey. Many companies (the least flagrant violators) expressed a desire to improve their own personnel administration. A survey taken recently, however, proves that no appreciable changes have been made. If anything, the situation is worse than it was, particularly with reference to senior engineers.

In exchange for unlimited clerical assistance, 226 engineers primarily in the missile/space industry, gave us their job-hunting result file and answered an exhaustive questionnaire. Legitimate resumes were sent to companies all over the U.S.; applications were filed; interviews were arranged; new positions were accepted. Conclusions:

- **Of every 10 resumes** submitted, two were ignored.
- **Of every 10 applications** submitted, two were ignored; two elicited turned down letters despite the fact that the information was exactly the same as that in the resume; four took longer than five weeks to reply, and two resulted in personal interviews.
- **Of the personal** interviews, one of every two took in excess of six weeks to follow a verbal offer with a written offer.

Paid Expenses

Of the 226 engineers and scientists who answered our questionnaire, 38 paid their own expenses for the initial interview because it took the prospective employer too long to issue the invitation-to-travel.

Twenty-three respondents did not accept the position they preferred, the one that would have made full and complete use of their capabilities, because the companies took too long to make a firm offer. Examples cited below are typical of all 23:

- **Human Engineer** with six years' experience in space research was interviewed and verbally accepted by Q Company. He resigned his position in anticipation of the forthcoming offer. One month and four phone calls later, the formal offer had not arrived. Was the delay caused by reference check? Clearance? Work history? No. The personnel administration could not agree on a salary. Human Engineer applied elsewhere, took a lesser, less fulfilling job because he could not afford to wait indefinitely for Q Company to reach a salary decision.
- **Missile Engineer** was verbally accepted during personal interview Oct. 1. "We need you desperately and immediately," he was told. His reporting date of Nov. 1 was reluctantly accepted, even though it was considered "too distant." He returned to his home to wait for the formal offer. It had not arrived by Nov. 1 despite the fact that he was still needed "desperately and immediately." What was the holdup? The personnel department had not allocated spaces. By the time spaces had been allocated, Missile Engineer had gone to work elsewhere.
- **Aerodynamicist** with 12 years' experience was placed by an "executive search" employment agency. Three representatives of one company interviewed him with the final word being, "We'll let you know your reporting location in a week." Six weeks later he received a telegram from a fourth representative of the same company asking him to come to another city for still another interview. He accepted another position.

These are not isolated cases. Companies spend in excess of $8.7 million annually in recruitment advertising, plus millions more to bring engineers to the facility for personal interview, only to have all efforts bog down in paperwork that should have been completed before the ads ever appeared in print.

Outstanding engineers and scientists are shunted from one untenable job to another, their full abilities never used. The "right" job eludes them primarily because of poor personnel administration. When an experienced technical man answers an ad, he's looking for a job. If verbal job offers cannot be followed-up within 10 days by firm offers, respondents felt that the company had no right to advertise the job or interview the prospective employe.

Dr. Max A. Pape and Nikki Kaye, who prepared this survey, were partners in Pape Research Associates at Los Angeles, Calif. Dr. Pape since has joined Hughes Aircraft Co. Systems Analysis Laboratory and Miss Kaye is a magazine editor.

In the published report of our original survey three years ago, the outstanding complaint was that personnel people were unable to read and interpret applications. Three years later, this complaint is louder than ever. For example:

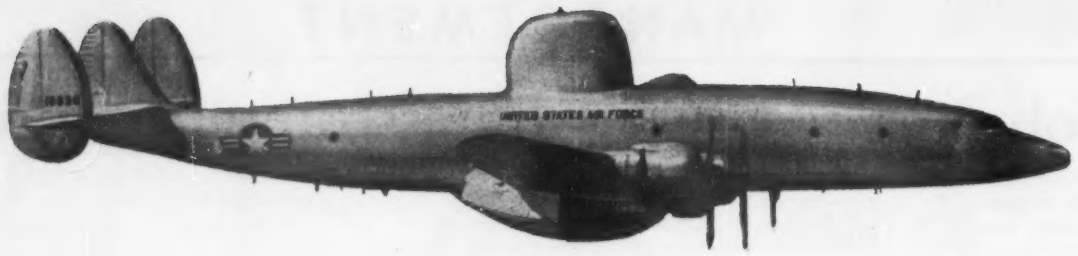
- **Engineer applying** for a position in weapon systems analysis gives as background "logistics." The answer—"You're not interested in us; we deal with hardware." (Logistics *is* hardware.)
- **Engineer applying** for an administrative position, turned down because "We want someone with R & D experience." Applicant had spent six years with Air Research and Development Command—as stated in both resume and application.
- **Resume and application** show applicant holds a doctorate. Only one company in 10 read the resume or application carefully enough to address the applicant as "doctor."

Paperwork Delay

Within many organizations, departments are urgently in need of technical help. Companies advertise, interview, hire, but months pass before the prospective employe joins the company. Nine times out of 10, the delay is caused by poor paperwork routine. Money, time and effort are wasted because of inability to interpret a resume. When personnel people do not know where in a company to send a resume, they manage to kill at least 14 days' time by insisting on a formal application blank which usually contains no information not contained in the resume. (Many of the over-long, over-detailed application blanks neglected to mention security clearance.)

Over the years a formidable wall of misunderstanding has grown between the technologically advanced and administrative personnel. Our 226 respondents considered treatment on the part of personnel departments to be part of the Great Leveling Process, or a further manifestation of the rift between the non-technical and the technologically advanced. Our survey showed conclusively that engineers and scientists move from company to company not necessarily for more money, but for a chance to work in human and professional dignity.

Respondents are attracted, and favorably impressed by intelligent, fast action on the part of personnel people. Unnecessary delays send them to other



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The AN/APS-95 is a fitting tribute to the 35th ANNIVERSARY OF HAZELTINE CORPORATION. Pictured above is the Radar Set Control of this important system.

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companies. Like workers in other fields, the technologically advanced feel a need-to-be-needed. It seems the unexpressed aim of administrative personnel to kill this need in the hiring process.

Letters of turndown are always touchy. Although engineers do not pass around the letters, they do pass around the sour taste. One company's "we regret" letter, sent to a scientist with 14 years' experience, was signed by the College Placement Advisor. This one letter has cost the company at least 20 applicants.

Most companies (eight out of 10) do not return personal papers, photostatic copies of college credits, or copies of published papers, nor do they reply to letters asking for the return of these papers. Although most letters of turndown use the phrase, "we will keep your application in our active file," later inquiry produces a blank.

The wall between personnel people and the engineers is growing higher and thicker. Show the engineer or scientist that he is needed, wanted, important and he'll work longer hours for less money. Continue letting him know he's merely a body, just one-of-many, and costs increase in salary, relocation expense and replacement. The time has come for a reappraisal.

Temco Receives More Corvus Commitments

Dallas, Tex.—"Significant" follow-on commitments on the Corvus air-to-surface "stand-off" weapon system for Navy are now being made formal, according to Temco Aircraft Corp. President Robert McCulloch.

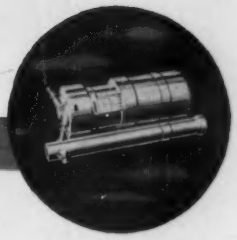
This was one of the encouraging items reported during revelation of the company's sales for the first nine months of this year, which totaled $77,785,740 providing net earnings of $864,400, equal to 51 cents on the common stock outstanding. Sales for the comparable period last year were $89,705,771 and earnings were $1,820,600 or $1.07 per share.

Decrease in profits was laid to costs of setting up production facilities at the company's subsidiary, Fenske, Fedrick & Miller, Inc., which is marketing the Iconorama multi-channel air and surface traffic plotting system and increased diversion of funds toward research and development programs.

He reported that orders received by Temco are up 26.6% and he believes the company is "at the bottom" of a declining curve of business.

Backlog of firm orders, letters of intent and contracts under negotiation amounted to $100,000,000 as of Sept. 30, compared with $103 million a year ago.

PROGRESS REPORT



Miniature Electric Power Supply

THE NEED—Advanced missile weapons systems require a secondary power source to supply precise electrical power for such functions as fuzing, telemetering, and guidance. Power supply reliability, and package weight and size are critical. Environmental conditions are extreme.

THE OBJECTIVE—Because of their proved reliability, turbogenerators offer an optimum solution to the problem of precise power outputs over a wide range of ambient temperatures. The objective of an intensive TAPCO-sponsored design and development program was to miniaturize turbogenerators to meet weight and envelope requirements.

TAPCO'S CONCEPT—With the benefit of many years of experience with turbines, alternators and controls, TAPCO engineers have designed and developed MINIAPS—a solid-fuel miniature turbogenerator with multiple output capacities.

MINIAPS is a compact and light-weight, self-contained and self-regulated secondary power system. It includes a high-speed turbine and a compound electrical generator on a single shaft, and an interchangeable, plug-in type transistorized speed control. A gas generator utilizing a solid propellant completes the miniaturized package.

One of the significant features of the MINIAPS is the capacity to produce up to four different outputs of AC and DC, with AC frequencies precisely controlled. One version produces 50 watts of power for 90 seconds duration, yet weighs only 3½ pounds and is less than eight inches long. Other versions produce up to 200 watts. Duration of outputs can be varied by increasing or decreasing the size of propellant grain.

MINIAPS was developed at TAPCO within a 4-month schedule, and preliminary evaluation testing has been accomplished with success. The unit functions reliably in the temperature range of −65° to +160° ambients, delivering required outputs for the desired periods of time.

We would welcome an opportunity to tell you more about MINIAPS, and to discuss with you the application of TAPCO-developed miniature secondary power systems in your current and future programs.

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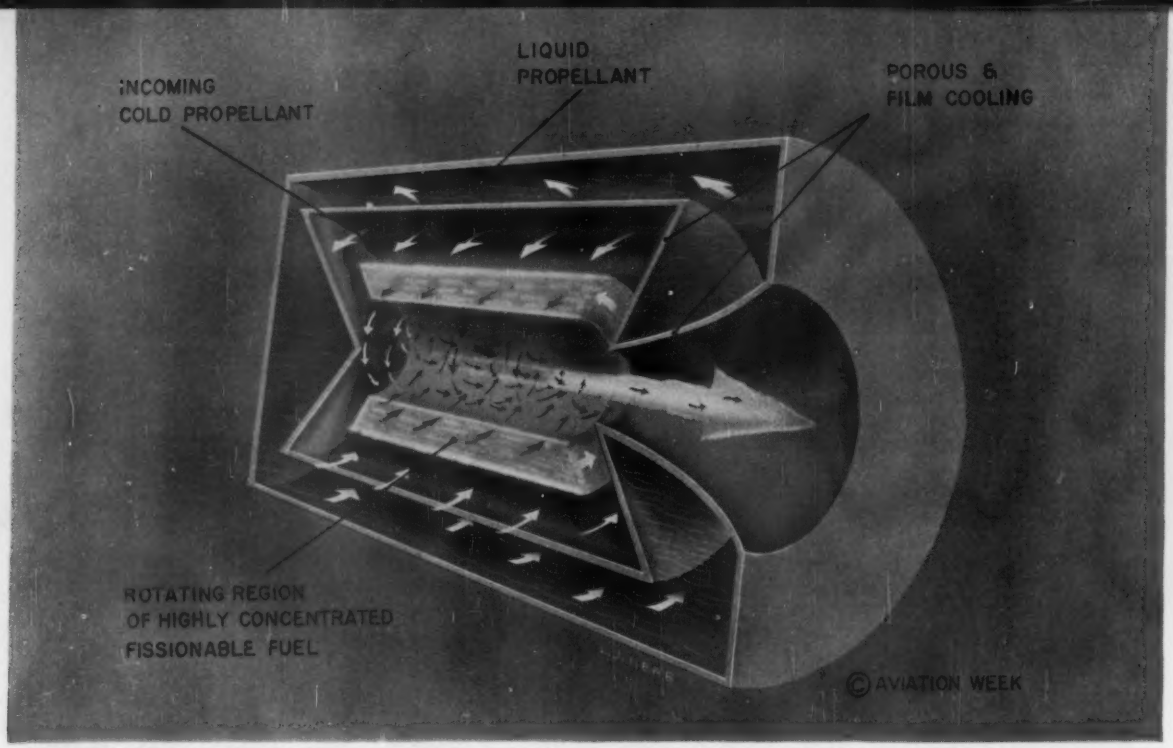
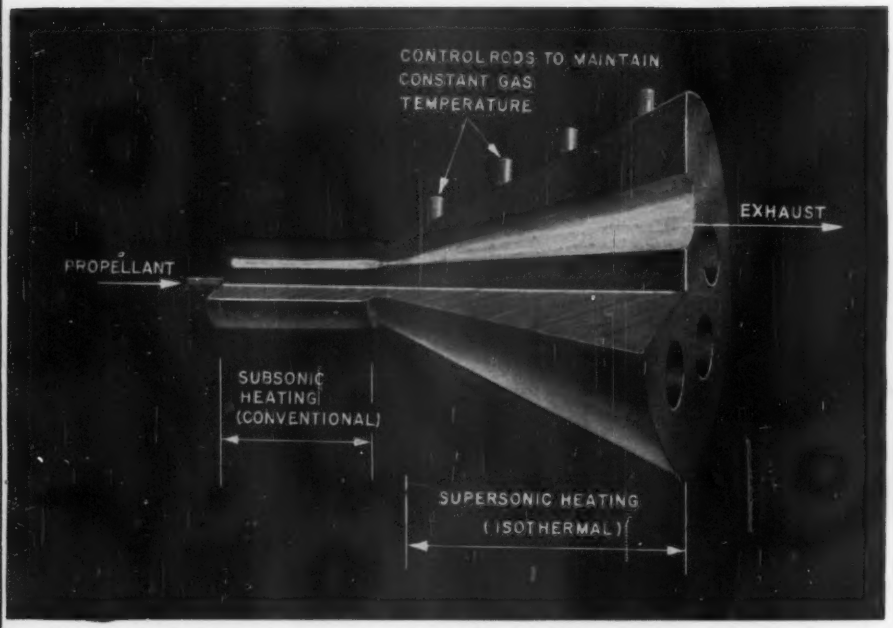


HYDRODYNAMIC containment of the gaseous fuel in a gaseous core nuclear rocket is shown in the artist's conception above. Rockets of this type can theoretically operate at temperatures several times higher than the solid fuel nuclear rocket which requires a heat exchanger made of solid materials. In the gaseous reactor above, the light propellant is heated by diffusing through the heavy fissionable fuel which is kept away from the center by centrifugal action. Studies to determine the practicality of gaseous core rockets using hydrodynamic containment of the fuel are being conducted by Princeton University, the AEC and the NASA.

Advanced Nuclear Space Units Probed



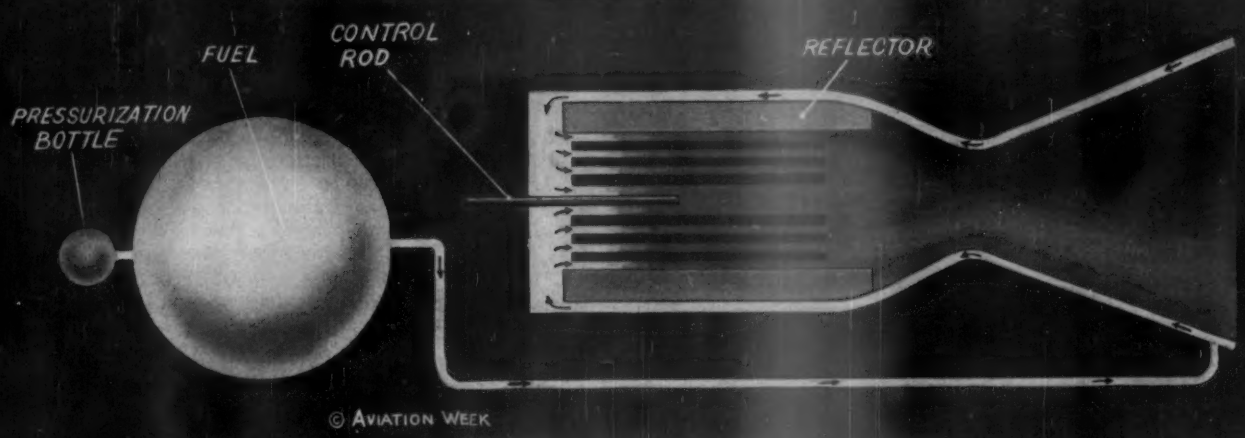
SOLID FUEL nuclear rocket in which the nozzle is a part of the reactor is being studied to increase specific impulse. Theoretically, a large quantity of energy can be added to an exhaust flow using this type of constant temperature nozzle. Exit Mach numbers up to five are believed possible. This prediction depends on efficient supersonic heat transfer from the nozzle wall to a dissociating propellant. Tests to determine if this is practical are planned.

By J. S. Butz, Jr.

Washington—Detailed study of possible configurations for nuclear rocket space propulsion systems is now expanding well beyond the Kiwi-A type solid-fuel reactor, high-pressure experimental engine under study by the Atomic Energy Commission at Jackass Flats, Nev. (AW Feb. 16, p. 49).

Advanced studies are in progress at a number of educational institutions, the AEC and the National Aeronautics and Space Administration. Variety of the work being undertaken by educational institutions are indicated by the projects under consideration by Jerry Grey, Princeton University professor of Aeronautical Engineering. They include:

- **Gaseous fuel nuclear rockets** that employ hydrodynamic containment of the fissionable material. A specific impulse of over 2,000 sec. at a vehicle thrust-to-weight ratio of 1.0 appear possible with gaseous fuel rockets because the transfer of nuclear heat is not limited to the allowable operating temperature of a solid material heat exchanger.
- **Kiwi-A-type solid fuel reactor** rockets that have a chamber pressure of less than 1 psi. Almost complete dissociation of the propellant is a possibility under these low pressures so that the



LOWERING chamber pressure is one of the ideas being investigated to increase the specific impulse of a Kiwi-A type solid-fuel heat exchanger nuclear rocket. Normally, the chamber pressure on this type of rocket would be several hundred psi., but dropping it to 0.2 psi. would cause almost complete dissociation of liquid hydrogen propellant, lower the mass of its exhaust particles up to 40% and, therefore, raise its specific impulse the same amount. Schematic (above) of a low pressure nuclear rocket illustrates the fact that it would not need a propellant pump or turbine. Possibly nozzle could be cooled by radiation, eliminate any regenerator or film cooling arrangements.

specific impulse using liquid hydrogen could be increased by almost 40%.

• **Large solid-fuel nuclear rockets** in which the nozzle is a part of the reactor. This arrangement provides an approximation of an isothermal nozzle and allows energy to be added to the propellant flow over the entire length of the engine.

Advanced studies are in progress at a number of educational institutions, the Atomic Energy Commission and the National Aeronautics and Space Agency.

A gaseous core nuclear rocket using hydrodynamic containment of the fissionable fuel was studied by Dr. Grey as an alternative to electromagnetic containment with its requirement for heavy coils and power generating system. Hydrodynamic containment is possible because the mass of the fissionable atoms is much higher than that of the propellant.

If a mixture of fissionable fuel elements and propellant is injected tangentially and at high velocity into a cylindrical combustion chamber, a concentration of gaseous fuel builds up near the wall. The propellant will diffuse through the fuel to the center of the chamber and stream out of the nozzle.

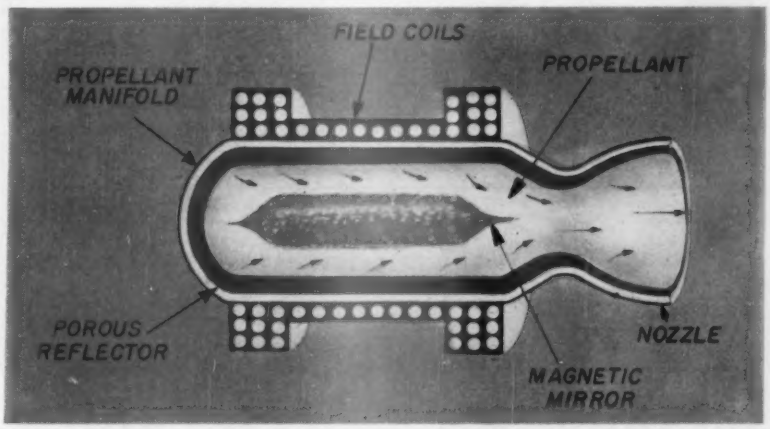
As the fuel mass builds up, it will become critical and begin to heat the propellant which also acts as a moderator for the fission reaction. The temperature of this reaction could be several times higher than the 6,000F now considered to be an absolute maximum for solid fuel reactors. Heating of the wall by conduction from the hot gases will be negligible because of the film cooling provided by the cold incoming propellant. Maximum temperatures in the rocket would be determined by the large thermal radiation of the reacting gases.

It is reasonably certain that the hydrodynamic containment scheme would help eradicate one of the main objections raised in the past against the use of a gaseous core rocket—that exhausting fissionable material out of the rocket at a rapid rate when a uniform mixture of fuel and propellant was considered would create an unacceptable hazard.

It is believed that the amount of radioactive material spewed out during the flight of a rocket using hydrodynamic containment would be smaller than that released by a small bomb. This would be within safety limits, but it could still create a considerable controversy.

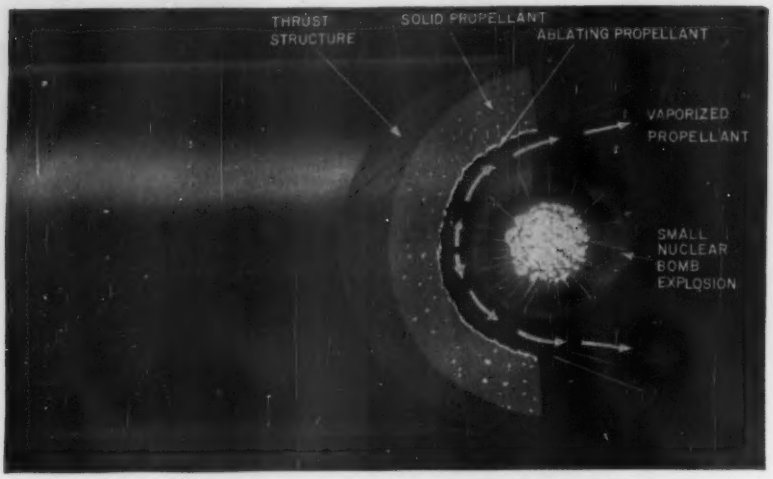
However, there are a number of uncertainties regarding the present theoretical studies which could make the practicality and feasibility of gaseous core rockets doubtful.

The first major uncertainty is the behavior and control of the critical mass of fissionable material swirling around



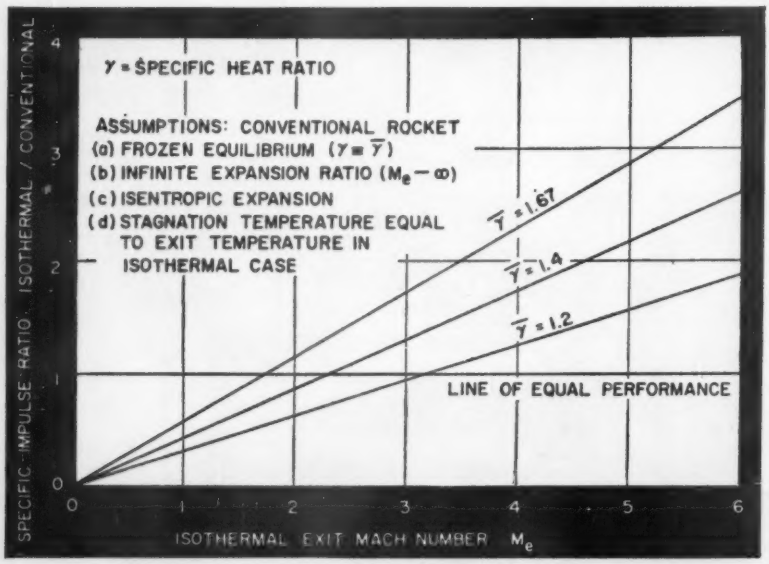
MAGNETIC containment for the fuel in a gaseous core nuclear rocket is the basic alternative to hydrodynamic containment. At the high operating temperatures of these rockets, the fuel would be completely ionized and could be squeezed to the center of the chamber by a "magnetic mirror" arrangement. It is possible that operating difficulties with these two basic containment ideas would require that they be combined. A combination system might use rotating fields to swirl fuel so that it would collect near walls by centrifugal action.

the inside of such a rocket. Fissionable elements would have to be injected at a definite rate into the propellant to start the rocket and, as critical mass was neared, the flow reduced to pure propellant.



Rocket Powered by Nuclear Bombs

Artist's conception of rocket powered by the explosions from a series of small nuclear bombs is shown above. This general concept is being investigated under the Atomic Energy Commission's Project Orion. General Atomics Division of General Dynamics Corp. has the principal industry contract under this project. Past objections to this type of rocket have been the great structural weight needed to resist the explosions, low average thrust-to-weight ratio and low average specific impulse. Interest continues to be shown in this fundamental idea, however. In the sketch above the solid propellant in the hemispherical base of the rocket might be replaced by the injection of a liquid fuel which would serve the same purpose of increasing the weight of the exhaust during each bomb explosion.



Isothermal Nozzle Increases Rocket Power

Theoretical increase in rocket performance that can be obtained with the use of the isothermal nozzle is shown above. Present opinion is that an exit Mach number of 5 can be obtained. If this is true, the use of a propellant such as dissociating hydrogen with a ratio of specific heats near 1.67 would make possible a three-fold improvement in the specific impulse of nuclear rockets.

Accurate control of the rocket's power by varying the temperature of this fuel mass is now a matter of some considerable doubt.

Crucial Separation

Crucial fuel separation and control experiments are now in progress in several U.S. laboratories. The results of this work sponsored by the Atomic Energy Commission and the National Aeronautics and Space Administration will be a major factor in determining the feasibility of hydrodynamic containment of a gaseous core reactor.

Another lack of experimental data which has forced broad assumptions and possibly serious errors in the theoretical studies of this engine, is in connection with the thermal emissivity of comparatively dense high temperature gases. Until this is known it will not be possible to determine just what the heat transfer to the combustion chamber walls will be and how high the allowable operating temperature can go. Knowledge of dense high temperature plasmas is growing rapidly with contributions being made by laboratories in a number of countries.

Engine Description

Engineering problems connected with a gaseous core rocket would be formidable.

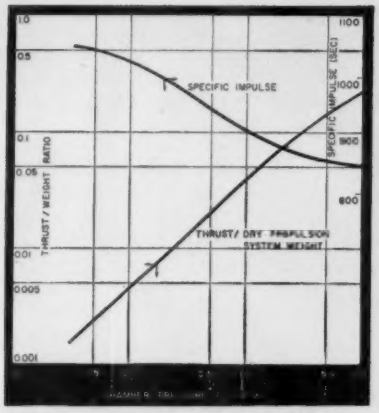
They are illustrated by a description of the engine within the limits of present knowledge:

- **Diameter of combustion chamber,** 5 to 50 ft. in diameter.
- **Minimum practical thrust,** .5 million to 10 million lb.
- **Minimum chamber inlet pressure,** 100 to 5,000 atmospheres.
- **Minimum useful temperature** of gaseous fuel, 30,000 to 100,000 deg. Rankine.
- **Propellant injection** would have to occur through numerous small orifices, making combustion chamber walls essentially porous.

Alternative

An alternative to pure hydrodynamic or electromagnetic containment which may prove attractive is a combination of the two. In this arrangement, the ionized fuel would be swirled by rotating magnetic fields, but separation and containment would depend upon centrifugal action rather than by squeezing the fuel plasma. The disadvantages of the large electrical system would be present, but it would be one way of circumventing the requirement for very high pressure drops in the chamber wall. Other configurations might prove necessary as design information becomes more concrete.

The fact that low pressures and high temperatures tend to promote the dissociation of gases has opened a new area



EFFECT of dropping the chamber pressure in a "conventional" Kiwi-A type heat exchanger reactor nuclear rocket is shown in the curves above. Specific impulse improvement with the low chamber pressure would result from almost complete dissociation of the liquid hydrogen propellant so that the mass of the exhaust particles would be reduced.

of study which would not be of interest for chemical fueled rockets but may prove useful for nuclear rockets.

Splitting the molecular bonds of the propellant gases during dissociation "soaks up" a large quantity of energy which could be used to increase the exhaust velocity and performance of a rocket. This sacrifice in energy and exhaust velocity cannot be tolerated in a chemical rocket. The finite limitation of available energy in chemical rockets requires that dissociation at the nozzle exits be kept to a minimum. If the most efficient energy expenditure is to be maintained, dissociation losses in the combustion chamber and nozzle throat must be counteracted by recombination and energy release during the temperature drop and expansion of the flow in the nozzle.

Efficiency Losses

This situation is reversed in the case of the nuclear rocket with its essentially unlimited energy. Efficiency losses can be accepted. It would be of no concern that a large amount of energy was lost in completely dissociated exhaust flow if an increase in exhaust velocity could be achieved (provided that allowable reactor power density is not exceeded). In fact, dissociation would help in this case because it would lower the mass of the exhaust particles and raise the specific impulse even more.

Studies at Princeton are directed toward obtaining experimental proof that dissociating propellants can be used in practical engines to achieve the theoretically predicted improvements in specific impulse. Two types of engines are under investigation.

The first is the low pressure rocket

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with the "conventional" Kiwi-A-type solid fuel reactor. With a very low chamber pressure in the neighborhood of 0.2 psi. and the 5,500F maximum temperatures of the heat exchanger reactor, a large percentage of the propellant will be dissociated when it leaves the engine with little recombination occurring in the nozzle. The mass of the exhaust would be lowered and the specific impulse increased by as much as 40%. The curves on p. 129 are theoretical estimates of the performance of this type rocket.

Space Use

The low chamber pressure gives this rocket a small thrust capacity and a thrust-to-weight ratio of less than one, confining its use to space. Two possible advantages other than the improved specific impulse are an uncooled nozzle and no requirement for a propellant pump and gas turbine to drive it. Low pressure on the propellant tanks would ensure proper feed, and radiation cooling of the nozzle might be adequate.

From a standpoint of possible gain in specific impulse, the isothermal nozzle is much more attractive than the low pressure rocket. The principal point is to show that the walls of a heated nozzle would add a large amount of energy to a supersonic flow of dissociated propellant gas. Heating a gas under these conditions is the exact reverse of the nose cone cooling problem during high velocity re-entry into the atmosphere.

Theoretically, it appears that heat transfer from a wall to a gas will be more effective if the gas is partly dissociated. The heat transfer is proportional to the difference between wall temperature and the temperature the gas reaches simply by passing through the boundary layer and being brought to rest at the wall surface. The latter is known as the adiabatic wall temperature. In a non-dissociating gas, this temperature is high and not too different from the gas stagnation temperature.

The heat transfer in this case would be low.

If a dissociating propellant is considered, the degree of dissociation increases as the relatively "cold" propellant moves toward the heated walls and its velocity drops. The adiabatic wall temperature of this propellant is well below that of the non-dissociating type because the "energy sink" of dissociation reduces the stagnation temperature.

Therefore, the heat transfer to a dissociating gas is high when compared with the non-dissociating class. One of the big questions surrounding the practical use of this mechanism is the diffusion rate of the "cold" gas through

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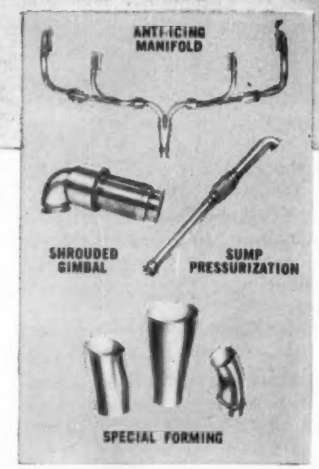

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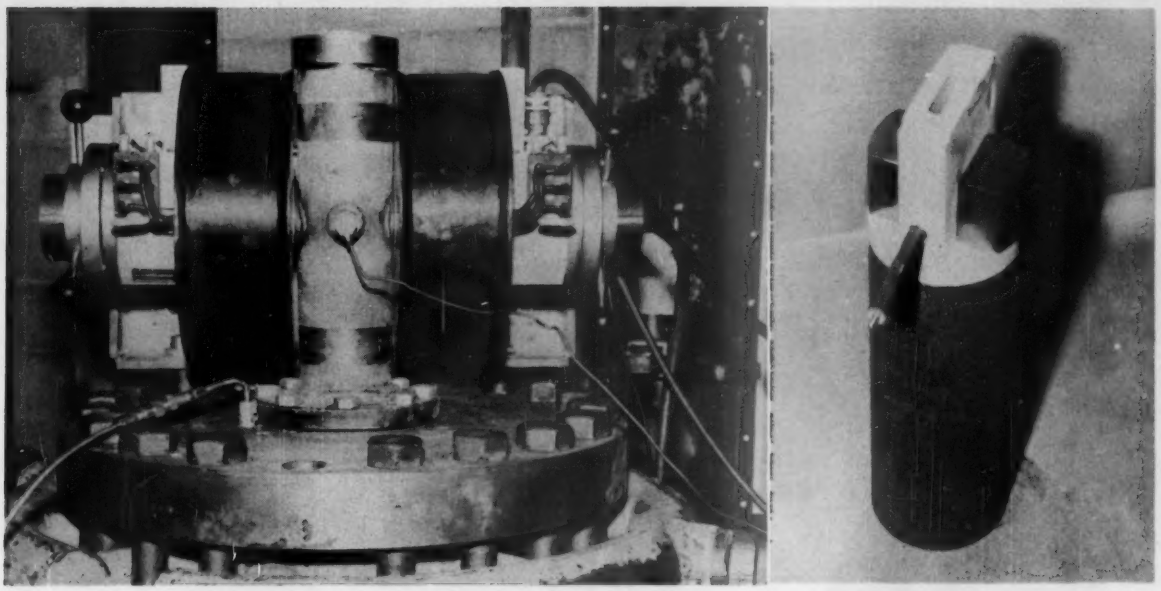

General Electric Ion Generator Has Space Application

General Electric has successfully obtained electrical power from an ionized gas flow with a new device called a megnetohydrodynamic generator. Absence of moving parts makes a unit a possibility for an auxiliary power source for space vehicles. Prototype MHD generator, shown at left, is bolted to top of General Electric's large air arc, the source of the ionized gas (a rocket exhaust or other high temperature gas—from 5,000 to 6,000F—also would suffice). Vertical steel cylinder in the center, flanked by the two poles of an electromagnet (black sections), contains the heart of the unit—a molded quartz generator with a narrow channel located on top of a hollow graphite cylinder. The graphite cylinder (above right), directs the hot ionized gas into the quartz channel and out the top of the cylinder. Attached to opposite narrow sides of the quartz channel and protruding through the steel casing are two graphite electrodes. Flush against the broad sides of the quartz channel are the pole pieces that carry the magnetic field to the sides of the quartz channel. In operation, the hot ionized gas flows up between the poles of the electromagnet, cutting the magnetic lines of force and creating a voltage.

the boundary layer. If it turns out that this rate is much lower than predicted, very long nozzles would be needed to add a useful amount of energy to the exhaust.

The weight of these nozzles could preclude their use.

Potential Speed

It is believed by those studying the problem that energy addition in a nozzle of reasonable length will allow exhaust Mach numbers approaching five.

The curve on p. 128 shows that the accomplishment might allow the specific impulse to be improved by a factor of three if propellants with high gammas such as highly dissociated hydrogen were used.

Schematically, the appearance of a nuclear rocket with an isothermal nozzle is shown on p. 126 (bottom). The thrust-to-weight ratio of such an engine would be less than unity because of its large size and low chamber pressure. It would be useful only in space.

New experimental program at Princeton now being planned is designed to prove or disprove these predictions. Methane or ammonia will be used to determine the exact effectiveness of supersonic heat transfer to dissociating gases.

Soviets Say Moon's Far Side Shows Continental Structure

Washington—Far side of the moon has a predominantly continental structure with fewer "seas," fissures and rays than the near side, according to Soviet scientists who have studied photographs relayed to earth from the third Russian lunar probe (AW Oct. 12, p. 28; Nov. 2, p. 26).

This is "extremely important for answering the question of how the lunar relief was formed" and is contradictory to the theory held by Franz of Germany that there should be a huge sea in the center of the far side, Alexander Markov, head of a planetary study group at Leningrad's Pulkovo Observatory, told Tass news service. Markov said the photographs are being studied to see whether craters predicted by Wilkins of Britain are located as his hypothetical chart shows.

Further Studies

Further astronomical and geological studies will be made by rockets to help determine why huge depressions or "seas" developed on the side but not the far side, Markov said. Soviet scientists believe this happened because greater temperature fluctuations occurring on the near side during lunar eclipses "caused a more extensive cracking of the lunar crust on this side. . . . Another factor influencing formation of the relief of the moon's reverse side . . . is that it is not shielded by the earth from the meteorites that strike it in greater quantities than the visible lunar disk.

"Finally, influenced by the earth's gravitational pull, the tidal wave in the lunar crust and core should be stronger on the earthward side of the moon."

Fewer Fissures

Lunar specialist Vladimir Yezerskiy of the Kharkov Observatory was quoted by Tass as saying that the far side has fewer fissures than the 500 or so that appear on the near side.

Yezerskiy said the photos of the far side lack the white rays that are clearly noticeable on photos taken of the earthward side at full moon. Although the nature of the rays has not been finally established, many years of work at the observatory headed by Nikolai Barabashov "provide reasons for the belief

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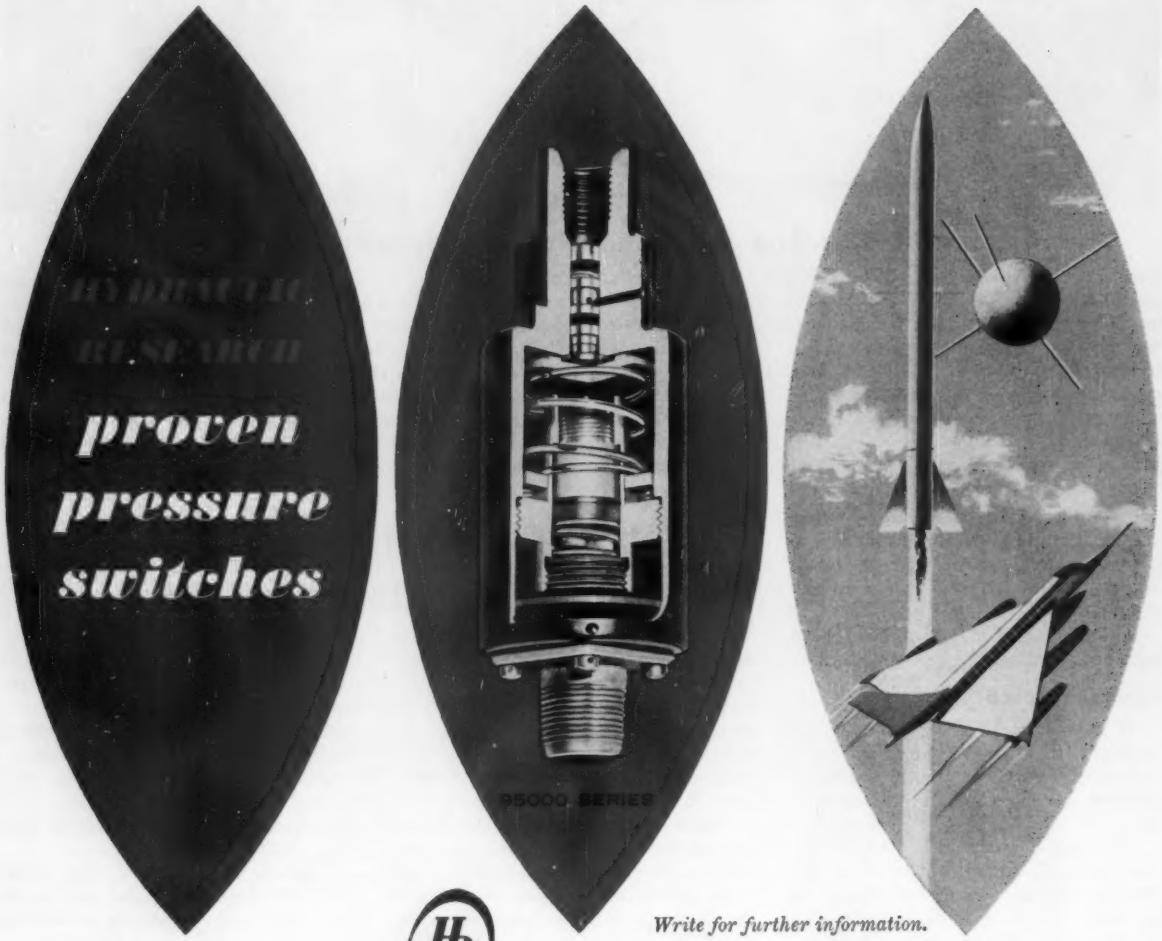

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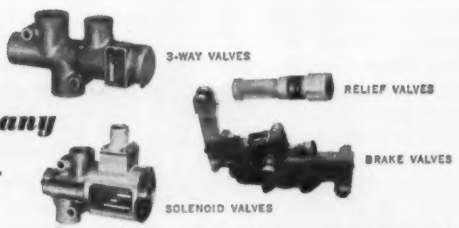

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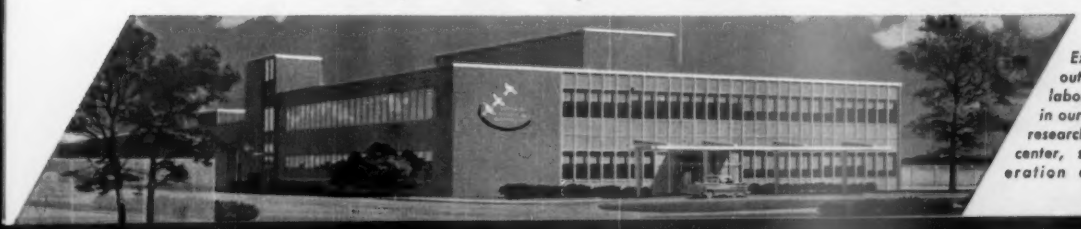

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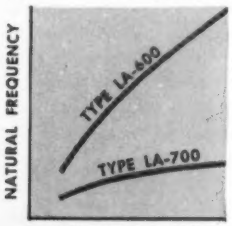

The LA-600 with its magnetic damping is used for higher natural frequency applications. The LA-700 with its compensated fluid damping is designed for lower natural frequency applications. Write for Bulletins LA-600 and LA-700 to Minneapolis-Honeywell, Boston Division, 40 Life Street, Boston 35, Mass.

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that these are formations of some white substance filling in the narrow and deep radial fissures," Tass said.

Detailed analysis of the lunar photos will require more than a month, according to Alexander Nesmeyanov, head of the Soviet Academy of Sciences. He said the penetration of outer space begun by "such daring leaps and bounds" as the lunar probe "will not stop."

Primarily because of the sun's influence on the trajectory, the photographic probe's apogee is increasing, having reached 300,000 mi. from earth on Oct. 26, the Russians said. Consequently, the altitude of the perigee is decreasing. If the probe should pass to the south of the moon on its next close approach, as it did on the photographic run, the probe's life would be greatly increased, they said.

Camera Report

Possibly through a translation error, one report here indicated that the first and second Soviet lunar probes might have carried cameras. This report, translated from Pravda, did not agree with a Tass report of the same day.

"The over-all volume of scientific information transmitted along the radio contact channel, including shots of the images of the moon, greatly surpassed the volume of photographic information which was transmitted from the first and second Soviet cosmic rockets," the Pravda report said. The Tass report used almost the same phrasing but did not include the word "photographic."

Signals carrying the photo images were recorded on earth by four different means, according to Pravda. It said the recording was done "by special devices on a photographic film, on tape recorders possessing a high degree of stability in tape speed, on long-persistent cathode ray tubes, and on open recording devices using electrochemical paper."

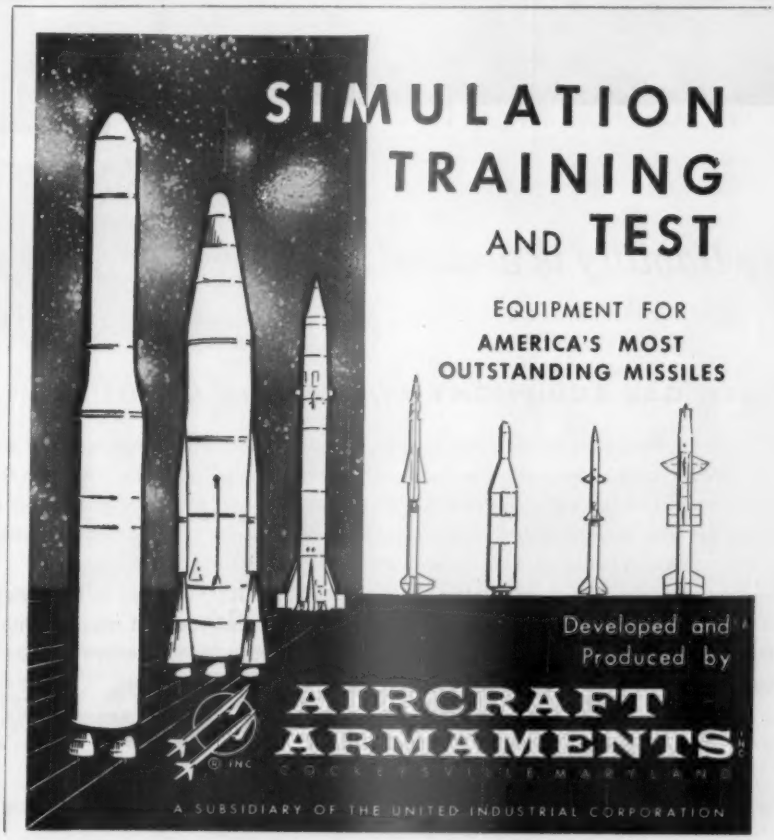
Convair Establishes Space Research Unit

Ft. Worth, Tex.—An applied research section which will concentrate initially on the environments and conditions surrounding space vehicles has been formally created at Convair's Ft. Worth Division. Such knowledge is essential for the design of vehicles of the type Convair anticipates for the future, according to physicist Dr. E. Leigh Secrest, who is in charge of the new section.

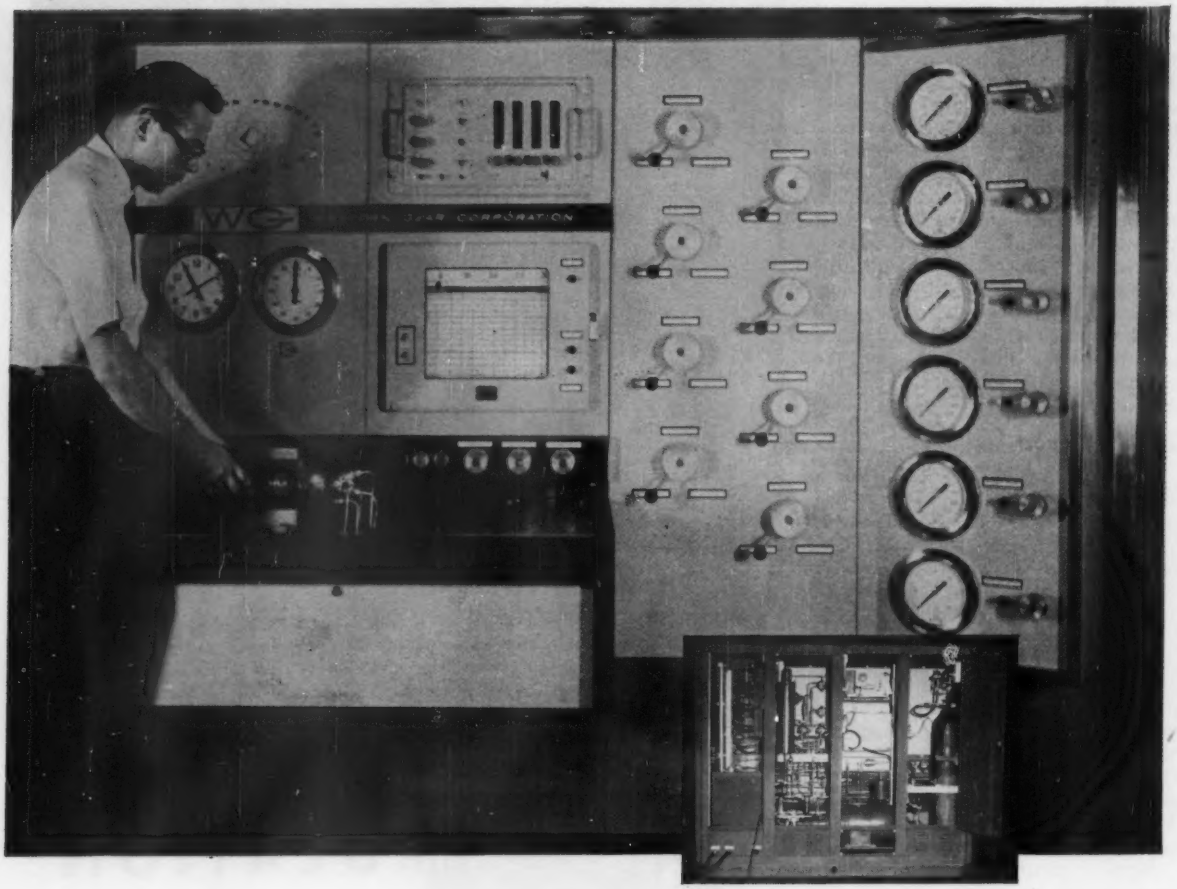
Initially the section, a part of the division's engineering department, will concentrate on such subjects as the nature of the outer atmosphere, physics of high-energy particles and astronomical sciences.

Lewis Research Center Space Ship Concept

Lewis Research Center concept of a hypothetical four-stage chemical rocket space vehicle would carry eight men on a round trip between earth and Mars satellite orbits. Upper structure at right is detachable living quarters; unit also carries the chemical rocket vehicle for a soft landing on Mars. Space ship itself is designed for operations in gravity-free areas, not to land on Mars, according to National Aeronautics and Space Administration.



Three system test stand console designed by Western Gear for field servicing of Convair F-106 Vari-Duct Drive unit. Fourteen individual performance tests guarantee reliability. High pressure hydraulic test at 4500 psi, low pressure at 300 psi, pneumatic emergency test at 2500 psi. Features built-in include safety precautions to prevent unit damage during test and calibration. Performs static, operational, load, stall and running tests, includes counter and recorder. Stainless steel piping throughout.



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Nine-Month Reports in Aviation Industry Generally Show Declines

Nine-month financial reports of major aviation industry companies generally were off compared with last year, but there were hopeful signs such as Boeing Airplane Co.'s improvement in the third quarter.

Boeing reported that a substantial portion of the estimated loss on its commercial jet transport program would be written off by year-end and that this should contribute to improved earnings in 1960.

Lockheed Aircraft Co. reported a third quarter net loss of $2,840,000 because of adjustments of $13.5 million in write-offs for its turboprop Electra transport, all made in the third quarter. However, this places the bulk of the Electra costs behind the company. This figure included some Electra vibration modification costs but was not solely confined to that item.

General Dynamics reported lower earnings, not only because of the Convair 880/600 development but also because of increased borrowing to meet engineering and development costs on other projects.

Fairchild Engine & Airplane Co., which lost $5 million last year because of expenses of its F-27 turboprop transport, reported a $728,000 profit for the nine months this year on sales of $86,217,000. Republic Aviation reported sales increased but profits fell.

Martin Co. reported increases in earnings and sales for the first nine months. Bell Aircraft Corp. and Temco Aircraft Corp., like Boeing, reported that sales and earnings for the nine months were down compared with last year's figures.

Boeing's third quarter sales total—$643,972,770—and earnings—$4,614,993—accounted for slightly more than half of its nine month totals. These were $1,131,066,874 for sales and $8,166,681 for earnings, the latter equivalent to $1.11 a share.

Last year the nine-month figures were $1,276,095,539 for sales and $27,328,805 for earnings, equal to $3.73 a share. Transition to fixed price contracts for the B-52G and Bomarc contributed to the third quarter earnings improvement.

Partly explaining the big drop in earnings on a relatively small drop in sales is the fact that Boeing wrote off $40,100,000 on its commercial transport project during the first nine months. Of this $9,400,000 represented the amount necessary to reduce work-in-progress charges on the 707 to estimated proportionate sales value.

With the transport program expenses written off, any additional orders would contribute that much more proportionately to earnings.

Boeing's backlog at Sept. 30 was $2,170 million compared with $2,387 million June 30. The September backlog includes $695 million in commercial orders.

Martin's nine month sales were $377,738,136 compared with $355,532,639 for the same period last year, and Martin Chairman George M. Bunker predicts sales for the full year will exceed $500 million.

Earnings for the company increased from $7,303,320 or $2.50 a share last year to $9,425,789 or $3.22 a share this year. Details of the other nine-month reports:

• **Bell Aircraft Corp.** reported sales of $94,920,189 and earnings of $1,516,098 or 56 cents a share, a drop from $141,365,876 in sales and $3,386,936 for the comparable period last year. Bell Chairman Leston Faneuf said the decline in earnings was the result of a decline in defense business in its Niagara Division and certain unusual expenses there, apparently references of research and development expense on the Dyna-Soar program in which Bell was a competitor on a team with Martin.

• **General Dynamics** nine month sales were $1,186,046,000, approximately $32 million more than sales for the same period last year. Net income this year was $16,845,000 or $1.70 a share compared with $28,740,000 or $2.92 a share last year. Total development expense on the Convair jet transport was $65 million as of Sept. 30. Backlog for the corporation on that date was an all-time high of $2,502 million.

• **Lockheed** reported earnings for the nine months of $6,197,000 or 88 cents a share compared with $13,482,000 or $2.11 a share for the same period last year. Sales—two-fifths of which were in the missile or space field—totaled $939,108,000, a 36% increase over last year. Backlog stands at $1,059 million. Commercial sales for the period were $203 million.

• **Republic** reported sales increasing from $133,545,062 for the period last year to $152,952,050 this year, but earnings fell to $2,640,254 or $1.79 a share compared with $3,918,363 or $2.66 a share. Republic reported a $500 million backlog, primarily in the F-105 program.

• **McDonnell Aircraft Corp.** for the first quarter of its fiscal year reported earn-

Von Karman AEDC Facility Dedicated

Von Karman Gas Dynamics facility at Arnold Engineering Development Center attracted top missile and space figures for its dedication. Inspecting models used in the high velocity wind tunnels are, from left, Dr. Theodore von Karman; Lt. Gen. Bernard A. Schriever, commander Air Research and Development Command; Dr. Hugh Dryden, deputy administrator, National Aeronautics and Space Administration; Dr. J. V. Charyk, USAF assistant secretary for research and development, and Maj. Gen. Troup Miller, Jr., AEDC commander. Models are an Atlas wind tunnel test shape (center) and an AGARD tunnel calibration shape at the left.

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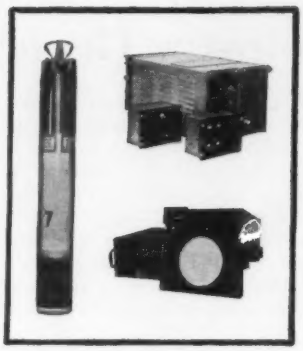

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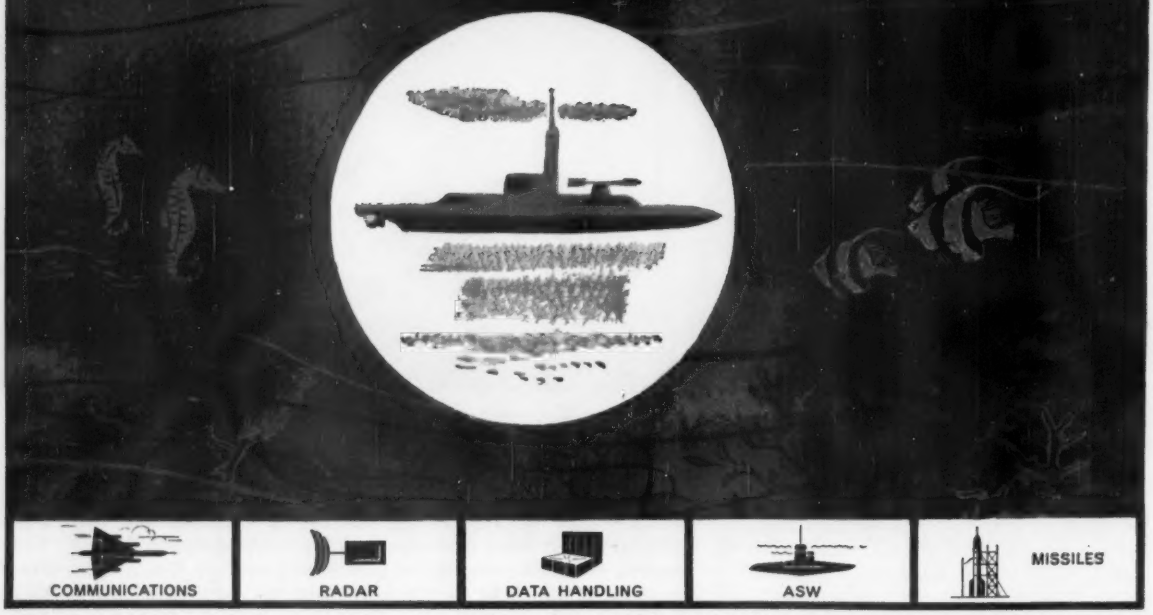

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ings of $2,423,692 or $1.47 a share on sales of $99,157,661. This compared with earnings of $2,012,071 or $1.22 a share on sales of $109,003,509 last year. This represented an increase in profit margin from 1.8% last year to 2.4% this year. Backlog on Sept. 30 was $613 million compared with $472 million on that date last year.

New Offerings

Hydromatics, Inc., Livingston, N. J.; principal business the manufacture and sale of ball valves used by the missile and aircraft industry. Offering is 105,000 shares of common stock for public sale; 80,000 shares to be sold by the company, and 25,000, representing outstanding stock, by the present holders. Proceeds will be added to working capital; a portion will be used to retire short-term bank borrowings and to purchase additional machinery and equipment.

Tennessee Gas Transmission Co., Houston, Tex., owner of a half interest in Grand Central Rocket Co., Redlands, Calif. Offering is 300,000 shares of cumulative convertible second preferred stock ($100 par) for public sale. Proceeds will be applied against outstanding short-term notes issued under the company's revolving credit agreement, proceeds from which were used in the expansion of company properties. The current expansion program will require expenditures of $64 million.

Dyna-Therm Chemical Corp., Culver City, Calif.; principal business the manufacture and sale of flame-retarding and heat-resisting coatings, including a mastic-type coating for military and industrial use. Offering is 200,000 shares of capital stock for public sale at $3 per share. Proceeds will be used to pay a part of the purchase price of the stock of Plas-Kem Corp., a subsidiary; to pay a $60,000 bank loan; the balance for working capital.

Consolidated Diesel Electric Corp., Stamford, Conn., engaged in the design and production of specialized lines of equipment for the support and servicing of missiles and military and commercial aircraft. Offering is $1,000,000 of 6% convertible debentures, due 1975, for public sale at 100% of principal amount. Proceeds will be used to discharge "Sunday indebtedness" of subsidiaries; to replenish working capital; to finance increasing commercial business of the parent and subsidiaries, and other corporate purposes. The company has arranged to procure a long-term loan, conditional upon sale of the debentures, the proceeds to be used in large part to refund most of the out-

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for holders of advanced degrees now exist in Boeing Wichita's tremendously expanded long-range research and development program for **PHYSICISTS** or **ELECTRICAL RESEARCH ENGINEERS** to conduct acoustics and noise control research supporting advanced designs; to analyze survival properties of advanced vehicles in present and future environments; and evaluate the potential of vehicle defense proposals... **ANTENNA DESIGN ENGINEERS** to conduct research and development leading to miniaturization of antennas by use of loading dielectrics and/or ferrites... **CONFIGURATION DESIGNERS** to create military and civilian vehicle designs based on general missions parameters... **DYNAMIC LOADS ENGINEERS** to conduct research in existing and future air/space loads... **OPERATIONS AND WEAPONS SYSTEM ANALYSTS** to estimate operational utilities of various devices under study by Advanced Design and recommended optimum design parameters, using advanced (IBM-709) computer aids. Qualified engineers should communicate their interest in any of these top positions to Employment Manager, Mr. Melvin Vobach, Boeing Airplane Co., Department N16, Wichita 1, Kans.

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standing obligations incurred to finance the acquisition of the business now conducted by the Hammond Valve Corp. subsidiary.

Gulton Industries, Inc., Metuchen, N. J., will offer 60,000 shares of common stock, the proceeds to be used for general purposes including retirement of $300,000 of bank loans incurred to carry inventories and a $300,000 program to build and equip a new plant for the company's battery division. The company develops and manufactures electronic, electromechanical, and electroacoustic components and instruments for military and commercial use.

Mergers And Acquisitions

Del Mar Engineering Laboratories of Los Angeles has acquired Electromation Co., Santa Monica, Calif., as a wholly-owned subsidiary which will provide Del Mar with a separate facility and organization for missile subsystems development. No management changes are anticipated. The subsidiary will serve as a military sales company engaged in research and development. Electromation has been manufacturing components for missile guidance applications, and producing Kinevox motion picture sound equipment.

Consolidated Electrodynamics Corp. and Bell & Howell Co. boards approved merger terms calling for distribution of three Bell & Howell shares for each four now held and for Consolidated shareholders to receive one share of the Bell & Howell common for one of Consolidated following this move. Consolidated makes aircraft and missile test equipment, electronic instrumentation, magnetic tape for data processing and vacuum systems and controls.

Stauffer Chemical Co. is proposing a merger with Victor Chemical Works on the basis of exchanging one share of Stauffer common for one share of Victor, exclusive of Victor shares already owned by Stauffer, and one share of Victor preferred for a newly authorized share of Stauffer 3½% cumulative preferred.

Telecomputing Corp., Los Angeles, acquired the Monrovia Aviation Corp., a wholly owned subsidiary of the Carrier Corp., for a purchase price in excess of $2 million. The sale by Carrier marks its intention for greater concentration in other areas, especially in its air conditioning business. Monrovia supplies structural subassemblies for the Boeing KC-135 and 707, wing tanks for the Lockheed F-104 and for various missiles including the Atlas and the Bomarc.

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Financial Briefs

General Precision Equipment Corp. expects sales this year to exceed $200 million for the first time. Nine month sales totaled $156,420,302 compared with $122,772,431 for the same period last year and earnings increased sharply from $915,612 or 5 cents a share last year to $3,043,628 or $1.91 a share. Backlog as of Sept. 30 was $202 million, compared with $168 million Dec. 31, 1958.

International Aviation Underwriters, Inc., San Francisco, is a new aviation insurance pool, reportedly the first in the U. S. to have headquarters on the West Coast. Included in the pool are the Peerless Insurance Co., the Stuyvesant Insurance Co., the American Fire and Casualty Co., the St. Louis Fire and Marine Insurance Co., the Transit Casualty Co., the Equity General Insurance Co., the New Zealand Insurance Co. and the Standard Insurance Co. C. Anthony Winser is president.

Westinghouse Electric Corp. directors recommended a two-for-one stock split for shareholder approval. Reporting strong increases in defense orders, the company said sales for nine months were $1,408 million compared with $1,384 million last year and net income was $56,225,000 or $3.17 a share, a 14.7% increase over the same period last year.

Radiation, Inc., Melbourne, Fla., reported sales and earnings increased for its fiscal year ended Aug. 28. The comparable figures: sales this year $14,005,734, last year $10,079,882; earnings, $588,993 or 66 cents a share this year, $488,738 or 53 cents a share last year.

Loral Electronics Corp. reported first half sales of $6,810,000, double the $3,220,000 for the same period last year, and earnings of $249,468, compared with $52,040 a year ago.

Ryan Aeronautical Co. declared a regular quarterly dividend of 5 cents per share on common capital stock payable Dec. 4 to stockholders of record Nov. 13. Stockholders also approved increase in authorized common stock available for issuance from two to three million shares with a stock option plan for selected employes. Optional plan would be limited to 100,000 shares.

Rolls-Royce, Ltd. earnings are not coming up to expectations this year. Backlog is running down and profit margins are getting narrower, the company says. In the first six months of this year, total sales, at $123.2 million, were $2.8 million less than in the corresponding period of 1958. Backlog now stands at $294 million, $22.4 million less than in early 1959.

Perkin-Elmer Corp. reported sales increased 16% to $17,514,079 for its fiscal year ended July 31. Earnings were $900,779 or 80 cents a share after a stock split a 20% increase over last year's $751,158 or 72 cents a share.

Siegler Corp. reported 1959 sales of $77,074,442 and earnings of $2,203,022 or $1.36 a share for its 1959 fiscal year. Last year sales were $72,955,449, and earnings were $1,215,930 or 80 cents a share.

Thiokol Chemical Corp. reported nine months sales of $127,883,796 compared with $54,607,976 for the same period last year. Earnings rose 134% to $4,060,355 or 92 cents a share.

Garrett Corp. reported first quarter sales of $50,027,782 and earnings of $1,444,750 or $1.40 a share. This compares with sales of $37,698,430 and earnings of $451,786 or 44 cents a share for the same period last year, marked by unusually heavy expense for proposals.

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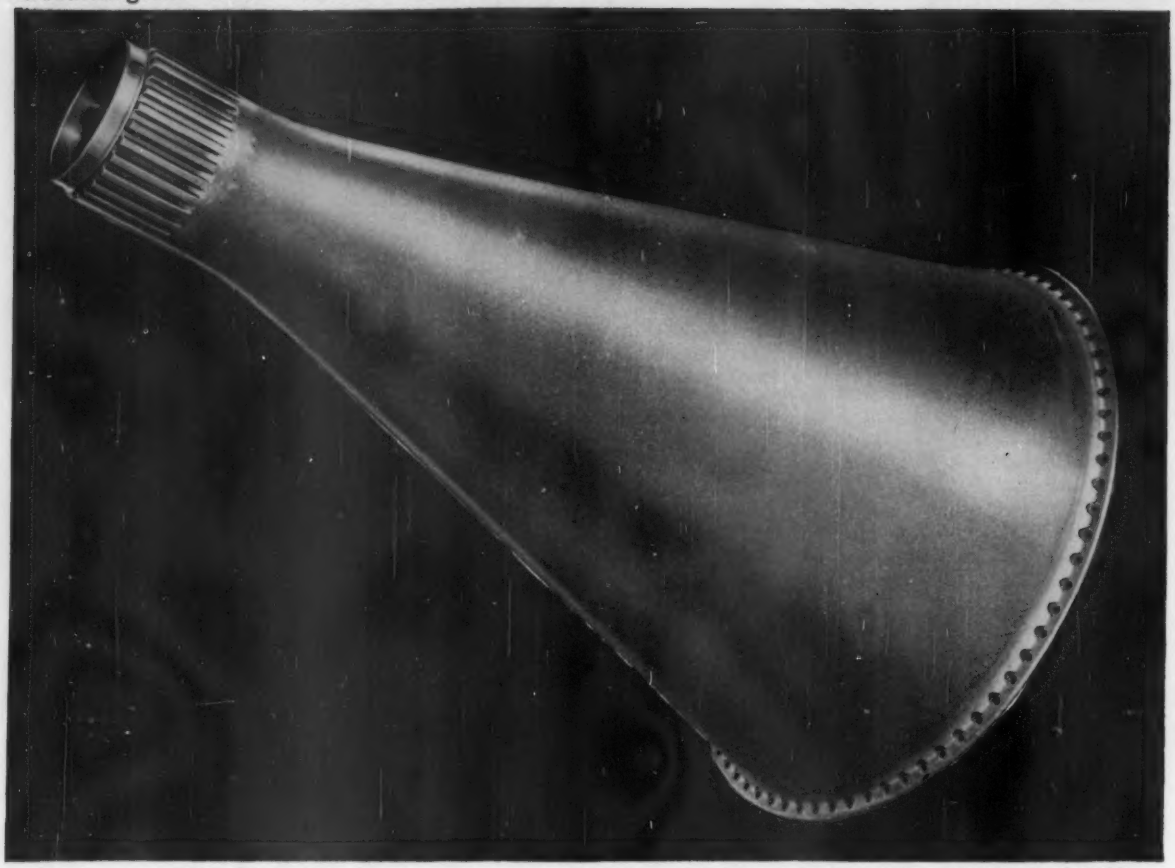

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WHO'S WHERE

(*Continued from page 23*)

Changes

John R. Morton, production engineering manager, Whittaker Controls Division, Telecomputing Corp., Los Angeles, Calif.

Robert E. Miller, manager, Advanced Development Staff, Melpar, Inc., Falls Church, Va. Also: **Dr. Charles E. Bergman,** appointed an associate on the staff.

National Engineering Science Co., Pasadena, Calif., has announced the following appointments to NESCO's senior technical staff: **Dr. Sedat Serdengecti, Dr. George N. Tyson, Jr.,** and **Dr. Herbert Landesman.**

Norman Pell, sales manager, Ketay Department, Commack, N. Y., Norden Division of United Aircraft Corp.

Bertram Klein, chief of structures, Solar Aircraft Co., San Diego, Calif.

John R. Quinn, manager-marketing operations, Eitel-McCullough, Inc., San Carlos, Calif.

A. J. Quackenbush, assistant to the director of flight and testing, Douglas Aircraft Company, Inc., Santa Monica, Calif. **R. W. Goedhart** succeeds Mr. Quackenbush as testing division representative in the A3D weapon system office at Douglas' El Segundo Division; Mr. Goedhart continues as testing division representative in the F4D weapon system office.

Sam L. Ackerman, program director-electronic products, Convair (Astronautics) Division of General Dynamics Corp., San Diego, Calif. Also: **Elwood D. Bryant,** works manager, Convair (Astronautics).

General Electric Co.'s Flight Propulsion Division, Cincinnati, Ohio, has announced the following managerial changes: **W. T. Harmon,** manager-product support, Production Engine Department, replacing **N. F. Frischhertz,** who is now manager-J79 engineering project, Jet Engine Department. Also: **J. D. Wethe,** acting manager-marketing, Production Engine Department.

Robert M. Gitlin, manager of engineering, East Coast plant of Fairchild Controls Corp.'s Components Division, Hicksville, N. Y., a subsidiary of Fairchild Camera and Instrument Corp.

James D. Redding, director of military applications, Remington Rand Univac Division of Sperry Rand Corp., with headquarters in Washington, D. C.

Lockheed Missiles and Space Division, Sunnyvale, Calif., has announced the appointment of the following psychology experts to the division's Satellite Systems Organization: **Dr. Robert L. Martindale; Dr. John M. Coyne; Dominic F. Morris; Joe D. Brower.**

William E. Howell, assistant manager, Chemical Propulsion Division, Hercules Powder Co.'s Explosives Department, Wilmington, Dela.

Richard W. Larrick, director of public relations, United Research Corp., Menlo Park, Calif., a subsidiary of United Aircraft Corp.

J. Lane Ware, associate laboratory director, Avionics Equipment Laboratory, ITT Laboratories Division of International Telephone and Telegraph Corp., Nutley, N. J.

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CAB Accident Investigation Report:

Cockpit Inattention Cited in 707 Dive

On Feb. 3, 1959 at 2205 G.M.T., Pan American World Airways Flight 115, a Boeing 707, N 712PA, en route form Paris, France, to New York, N. Y., made an uncontrolled descent of approximately 29,000 ft. Following recovery the aircraft was flown to Gander, Newfoundland, where a safe landing was made. A few of the 119 passengers and 10 crew members on board sustained minor injuries; extensive structural damage to the aircraft resulted.

The aircraft was flying at an altitude of 35,000 ft. in smooth air with the autopilot engaged when the captain left the cockpit and entered the main cabin. During his absence the autopilot disengaged and the aircraft smoothly and slowly entered a steep descending spiral. The copilot was not properly monitoring the aircraft's instruments or the progress of the flight and was unaware of the actions of the aircraft until considerable speed had been gained and altitude lost. During the rapid descent the copilot was unable to effect recovery. When the captain became aware of the unusual attitude of the aircraft he returned to the cockpit and with the aid of the other crew members was finally able to regain control of the aircraft. Recovery was made at an altitude of approximately 6,000 ft.

As a part of the investigation of this accident depositions were taken of the crew, personnel of the company, the manufacturer of the aircraft, manufacturers of various components, and the Federal Aviation Agency.

Following the taking of these depositions, the FAA, citing failure to comply with Part 41.62 (Pilots at Controls) of the Civil Air Regulations, levied a civil penalty against the captain. The copilot received a six-months' suspension of his ATR.

INVESTIGATION

Pan American Flight 115 of Feb. 3, 1959, was a scheduled flight between Paris, France, and New York, N. Y., with intermediate stops planned at London, England, and Gander, Newfoundland. The crew consisted of Cap. Waldo Lynch, pilot in command; Capt. Samuel Peters, copilot; J. Laird, navigator; G. Sinski, flight engineer; A. Leibner and R. Barton, pursers; and T. Clark, J. McCormack, J. Descoteaux, and P. Jones, stewardesses. Both of the captains in the flight crew were supervisory personnel and qualified as pilots in command of B-707 aircraft. The departure form Paris was routine and the trip to London was without incident.

Flight 115 departed London at 1845[1] with 119 passengers. The flight plan called for an IFR flight to Gander of 4 hr. 58 min. at maximum cruise thrust. The aircraft was to cruise at an altitude of 28,500 ft. to the South Shannon intersection, 29,000 ft. to 20 deg. west longitude, and 31,000 ft. to Gander. A routine operation was conducted until near 30 deg. west longitude where a frontal condition accompanied by heavy thunderstorms was encountered. Because the flight, flying at its assigned altitude, was passing through the tops of these storms in moderate turbulence and encountering light icing, clearance was obtained from Shannon and Gander OAC (Oceanic Area Control) to climb to and cruise at 35,000 ft. At this altitude the aircraft was on top with all stars visible.

At approximately 2150, Capt. Lynch went to the main cabin. Capt. Peters remained in the cockpit, seated in the copilot's seat. The aircraft was in maximum cruise configuration flying at Mach 0.82 in smooth air; autopilot was engaged in the manual mode and the altitude hold was on; gross weight was between 190,000 lb. and 195,000 lb.; and outside air temperature was minus 55C. The aircraft position was 52.5 deg. north latitude, 40.5 deg. west longitude.

All other crew members were at their stations and Mr. Mackey, a company dispatcher from Idlewild on an indoctrination trip, was seated in the observer's seat immediately behind the captain in command. Capt. Peters said his belt was snug and the seat was so adjusted that he had easy access to the controls.

At approximately 2200 the navigator posted a change in heading requiring a left turn of about 20 deg. Capt. Peters complied, using the turn knob of the autopilot in so doing. He said that he observed the new heading on his RMI (radio magnetic indicator) for several seconds and that the autopilot was holding the heading in a normal manner. He then began to work on the "How Goes It" curve attached to a clipboard resting on his lap, which necessitated computations being made as to time, distance, cruising speed, and fuel consumption, some parts of which are computed by the navigator. During this time his headset was positioned on both ears as he was waiting to copy the 2205 Gander weather broadcast, and he said he did not observe the forward instrument panel during this time.

The first indications he had that the flight was not proceeding normally was when he felt the aircraft buffet. This was immediate followed by a feeling that positive acceleration forces were building up rapidly.

The buffeting increased in intensity and his instrument panel lights went out. Quickly he looked at the captain's instrument panel which remained lighted and saw that the captain's artificial horizon had tumbled and consequently was of no use to him. He then glanced up and saw the stars moving rapidly counterclockwise, indicating that the aircraft was in a nosedown right spiral about to roll over on its back. At this point he grabbed the control wheel, pushed the autopilot release button, and attempted to stop the roll by applying left aileron and rudder, but by this time he was virtually immobilized physically by the pressures created during the maneuver. Various system-warning and fire-warning lights were being activated intermittently and the Mach warning bell was heard.

At this time Capt. Lynch with considerable difficulty returned to his seat. As he passed the flight engineer, Mr. Sinski reminded him that the power was still at cruise thrust. The captain pulled the power levers to idle position and pulled himself into his seat, which had been moved fully rearward when he left it. His normal seat position when flying is full forward, rudder pedals in the full aft position. Mr. Mackey and Mr. Laird, the navigator, had changed seats and the captain asked Mr. Laird, who was now immediately behind him, to hold him in his seat. Everyone in the cockpit was seriously affected by the g forces which made it difficult or impossible to move properly their heads, hands, or feet. Capt. Lynch said that his head was bent over and his feet seemed pinned to the floor.

Lynch Takes Command

A quick glance at his instruments showed the airspeed needle in the vacant area to the right near the zero mark, and the altimeter passing through 17,000 ft. with the needle turning at a terrific rate. He could not see the Mach meter because it was hidden by the control wheel and he could not lift his head. The artificial horizon was of no use to him because it had tumbled, and the turn and bank indicator was full to the right with the ball positioned slightly to the left of center. He quickly glanced at Copilot Peters and seeing him struggling with the controls shouted, "I have command." The stabilizer was in the full nosedown position and his electric trim button failed to function. Visual reference was imposible because they were in a cloud. Mr. Laird somehow managed to fasten the captain's safety belt and while this was being done Capt. Lynch rolled the wings level and the g forces were relieved. The flight engineer, now able to move, immediately pulled the circuit breaker which deactivated the stabilizer system and then straddled the console and began rolling both stabilizer wheels toward the up position by hand. As they pased through 8,000 ft. Capt. Lynch pulled the yoke back with a steady pull. At 6,000 ft. there was a terrific violent pounding or buffeting which lasted a couple of seconds and then the aircraft ceased to descend and began a fairly steep climb. At 9,000 ft. the wings were level and the aircraft was in a moderate climb. About this time the captain asked Flight Engineer Sinski to roll the stabilizer a bit forward and with the aircraft responding reasonably well to control demands he realized he had once again regained positive control. He then moved the horizon switch to the No. 2 position, selecting the No. 2

[1]All times herein are Greenwich Mean Time and based on the 24-hr. clock.

vertical gyro, and his artificial horizon responded normally; however, when returned to the No. 1 position his horizon registered normal pitch movements, but depicted a steep bank. Capt. Lynch noticed that the stabilizer cutout switch was in the on position and that the Mach trim switch was in the off position. After determining their position the flight immediately advised Gander OAC of the difficulty and a cruise altitude of 31,000 ft. was obtained for the remainder of the trip.

During the climb some of the passengers felt the need for oxygen and it was administered by means of the portable bottles and the cabin's regular oxygen system. The cabin pressurization system functioned in a normal manner throughout the entire event. When 31,000 ft. was attained, a long-range cruise configuration was set up with a speed of Mach 0.79 and the aircraft was manually flown to Gander without further incident.

On arrival at Gander the aircraft was carefully examined and it was determined that although it had sustained extensive structural damage it could, with minor repairs, be flown safely to the Boeing plant at Seattle, Wash., for final repair. Another B-707 was ferried to Gander to transport the passengers to New York. All passengers and crew continued the flight to its planned destination.

The damage consisted mainly of buckles in the lower surface skin of the right and left horizontal stabilizers and buckles in the center section web and upper surface doubler, and both wing panels were damaged including shear wrinkles in the rear spar webs and damage to the outboard ailerons and aileron control rods. The wing-to-fuselage fairings were damaged and a three-foot section of the right fairing separated in flight. Both wing panels suffered a small amount of permanent set. All four wing-to-strut fairing sections of the engine nacelle struts were buckled. No. 2 and 3 nacelle shear bolts partially failed in shear and the fitting holes of all front spar-to-wing bushings were elongated.

STABILIZER TRIM

During the early part of the descent the stabilizer pitch trim which varies the angle of incidence of the adjustable horizontal stabilizer was seen by the flight engineer to move toward a nose-down position. When Capt. Lynch returned to the cockpit the stabilizer trim was in the full nose-down position. The horizontal stabilizer may be varied electrically by means of an electric trim button on the upper outboard side of the pilot's control wheels. The autopilot disengage switch is located on both pilots' control wheels immediately below the trim control switch. Copilot Peters testified that during the descent he did not touch the electric stabilizer trim switch but that he remembered pushing the autopilot release button. He also said that the speed brake was not used at any time.

Because of the nature of this accident, certain systems and components of the aircraft were definitely suspect; these were the autopilot, Mach trim systems and their warning systems. As a part of the Board's investigation comprehensive tests of these systems were made at the Boeing Airplane Co. plant near Seattle, Wash., under the direction of a CAB investigator.

The PB-20D autopilot provides sensitive automatic, coordinated control of the aircraft. It incorporates all the necessary switches, including mode selector switches, for normal autopilot operation; in addition the system includes a comparator unit. Basically, the comparator is a second autopilot computer that monitors response of the autopilot. By keeping autopilot signals under constant observance it monitors against step command (hardover) signals or gradual error condition buildup (slow-overs) and automatically disengages the autopilot in response to such signals. The system is designed to be sensitive with respect to autopilot disengagements in the interest of safety and passenger comfort.

On several previous flights of B-707 aircraft there have been disengagements of the autopilot without the existence of a mechanical failure and after which the system functioned normally when the autopilot was re-engaged. One such disengagement occurred on the immediately preceding flight of the subject aircraft. On this occasion the warning light failed to come on and the crew became aware of the disengagement by observing a 20-deg. right-wing-low attitude on the horizon indicator. Before recovery was effected approximately 600 ft. in altitude were lost. The warning light was checked by the crew immediately after the occurrence and it did not light.

Functional tests of the autopilot system subsequent to the accident showed it to be operable in a normal manner with the following exceptions:

1. In several instances the autopilot disen-

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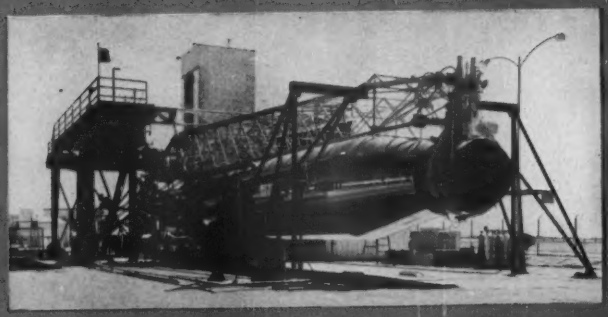

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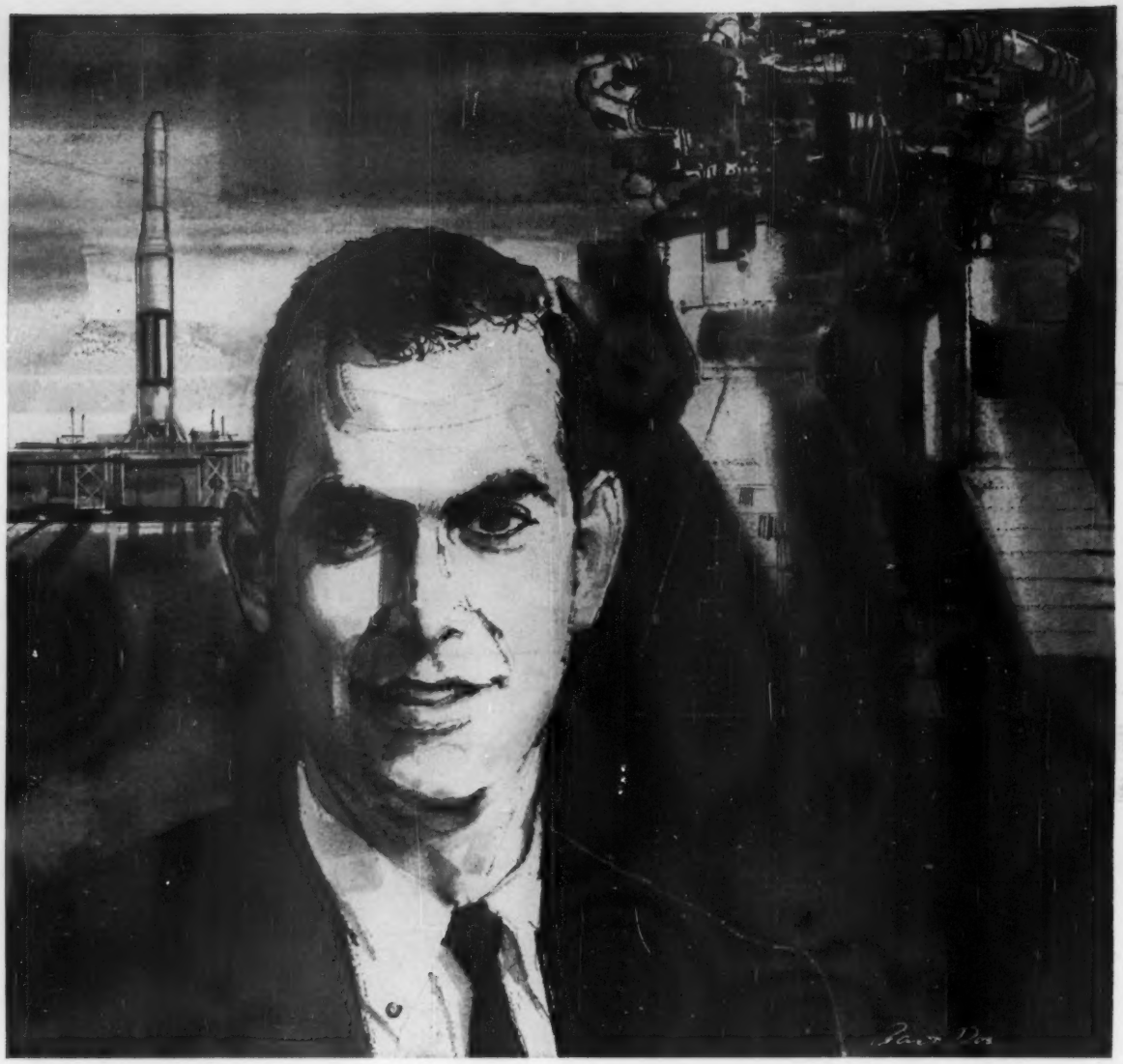

A. L. Feldman

Al Feldman is thirty-one. A Cornell BSME, he joined Aerojet as a development engineer in 1954. His present job: Head, Propulsion Systems Department, Liquid Rocket Plant, Sacramento. The assignment: design and development of rocket engines for the TITAN missile.

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gage warning light did not function properly after disengagement of the autopilot.

2. The pitch trim potentiometer did not re-center after autopilot disengagement. The mechanical centering of this potentiometer is necessary for the autopilot upon re-engagement to have available full nose-up or nose-down trim.

The principal components of the autopilot were bench checked. These also functioned in a normal manner with the following exceptions:

1. When testing the amplifier-computer it was found that the operation of relay K-14 was erratic. Two of the contacts within this relay serve the autopilot disengage warning light circuit. Detailed inspection of this unit disclosed a considerable misalignment of its internal structure, suggestive of the type of damage which might be expected if the relay had been dropped. The damage found resulted in certain of the contact pressures being below standard. In all other respects the relay appeared to be normal. Testing of the vertical gyro transmitter disclosed that the rate switch was inoperative.
2. The vertical gyro transmitter is an electrically driven gyro that provides the vertical reference for the automatic pilot. Incorporated in the assembly is a rate-of-turn control consisting of a hermetically sealed rate gyro and switch. At preset turn rates the switch turns off the vertical gyro erection system, thereby preventing erection of the vertical gyro to a dynamic vertical during turns. Examination revealed that the rate gyro motor windings were open. A crack was also noted in the glass dash-pot tubing. Subsequent to the examining group's inspection, Boeing engineering personnel observed that the rate switch would occasionally stick when closed manually.
3. As had been previously observed during the autopilot system checks, the pitch potentiometer failed to re-center when the autopilot was disengaged. The unit was opened and it was observed that travel of the actuating lever was excessive, causing a slight binding of the lever. Subsequent to the group's examination, this assembly was inspected by Eclipse-Pioneer Division personnel at their plant. They reported finding some of the solenoid sealing compound within the solenoid in such a way as to make it sticky.
4. Comparison unit tests indicated that a five-degree pitchup change of attitude as a step was required for disengagement as against the four-degree step change specified. It was also observed that the alarm would occur intermittently at 10 deg. noseup without the step change of pitch attitude normally required for an alarm.

The integrity of the aircraft wiring associated with the autopilot and Mach trim system was checked by making accurate resistance measurements of all circuits. In addition, the wiring in the two control columns, which forms the major part of the autopilot manual disconnect circuit, was removed and given a detailed visual inspection.

These checks disclosed no irregularities in the pertinent aircraft wiring.

The Mach trim system on the Boeing 707 is designed to aid in providing longitudinal stability during manual flight at high speeds. This is accomplished by adjusting the position of the movable horizontal stabilizer to counteract the aircraft-nosedown tendency at speeds of Mach 0.84 or above. This nosedown tendency at high speeds, or "tuck under" as it is sometimes called, is a flight condition pertinent to all high-speed sweptwing aircraft. Although the B-707 aircraft is designed to be controllable throughout the Mach trim range without the operation of this system, it is, however, required by Civil Air Regulations. The Mach trim system was tested and found to be operating in a normal manner. The Mach trim switch is turned on as part of the after-takeoff checklist; the crew members testified that they believed this was done on departure from London.

The Mach warning system serves to alert the crew of the approach of limiting airspeeds. This is done by means of a warning bell. A test of this system indicated that the bell center bolt was loose, thereby producing a buzzing sound rather than the clear ringing sound intended.

FLIGHT RECORDER

N 712PA was equipped with a Lockheed Aircraft Service Flight Recorder, model C, which continuously measures and records the aircraft's compass heading, barometric altitude, vertical acceleration, and indicated airspeed. The recorder in this aircraft is mounted in the left main gear wheel well and is connected to the aircraft's electrical power system through a switch on the landing gear scissors; it operates continuously when the aircraft is airborne. The measured parameters are recorded on aluminum foil tape by means of stylii which move transversely across the foil as the foil moves past the stylii at a uniform rate. A time trace is also impressed on the foil to facilitate the analysis of the recorded data. The tape, which winds from one spool to another, is driven by an electric motor through an escapement and gearing. The foil tape on a loaded spool is fastened to the spool by a piece of masking tape in much the same manner as photographic film is attached to its spool. The recorder will continue to operate even after the foil supply has been exhausted but the resistance of the masking tape is generally sufficient to "stall" the spool drive mechanism. When this occurs the various stylii markings are superimposed (or nearly so) upon themselves and it is difficult, if not impossible, to obtain any intelligence from the recorded markings. A 100-ft. roll of aluminum tape is used in the recorder and this is sufficient for approximately 150 hr. of recorder operating time.

When the recorder on N 712PA was examined after the accident, it was determined that the foil supply had been exhausted at the time of the accident. Records revealed that the recorder, SN #103, had been installed on N 712PA on Jan. 19, 1959, by a PAWA mechanic who had obtained the recorder from the PAWA stockroom at Idlewild. The unit had been stored in the stockroom since its return from Lockheed Aircraft Service following a repair by that organization. The mechanic verified that the tape was in the recorder but he did not, nor would he ordinarily, measure the length of the tape after the accident disclosed that

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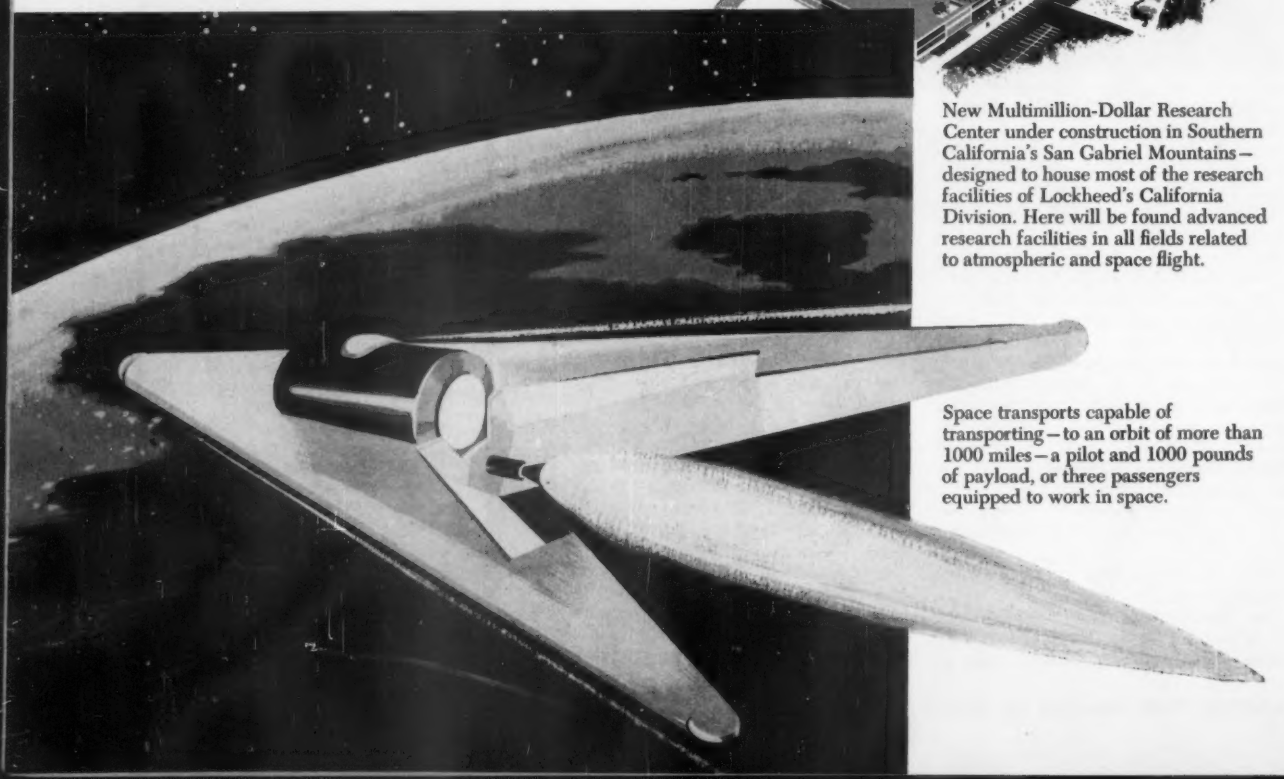

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instead of the usual 100-ft. length the tape was only 51 ft. long. Further investigation disclosed that 18 flight segments, covering 71:26 hr., were recorded on the tape from Jan. 21 until the tape was exhausted on a westbound flight on Jan. 27, 1959. From this latter date nine flights, covering 43:18 hr., were made during which intermittent record advance totaling .35 in. occurred as a result of slippage of the masking tape retaining the foil tape to the spool. The ninth flight was the one involved in the descent maneuver.

In an effort to derive as much information on the motions of the aircraft as might be feasible, the tape was returned to Lockheed Aircraft Service, Inc., at Ontario, Calif., where a detailed microscopic examination of the record was made under the supervision of Board investigative personnel. Although the record was abnormal because of the minute intermittent slippage of the tape, and although it was not always possible to correlate the recorded parameters relative to time, some valuable information was obtained by this examination. The abrupt descent from 35,000 ft. to 6-8,000 ft. was verified and it was indicated that the airspeed reached by the aircraft was equivalent to a Mach number of 0.95. The heading trace was particularly difficult to interpret because of the poor record but it was indicated that the aircraft had made several turns in the diving, spiral descent. Accelerations representing very high g-forces were indicated; however, it is believed that these were too high and were probably influenced by the manner in which this record was made.

This flight recorder record was of assistance to the Board investigators and it is unfortunate that owing to tape exhaustion a more reliable record was not obtained.

ANALYSIS

From all of the available evidence it appears that during the captain's absence from the cockpit the autopilot disengaged and the copilot did not detect that the aircraft had entered a steep nosedown right spiral. It is further evident that it entered this maneuver gradually without any abrupt movements. Also, since the accident was during the hours of darkness, the autopilot disengage warning light (a flashing red light) should have been observed by the crew unless it either failed or was almost completely shielded by the dimming cap. The latter appears probable as the cap was found in the full dim position at Gander.

The functional checks conducted on the autopilot system and its components disclosed certain minor discrepancies. These must be evaluated as to what effect, if any, such discrepancies would have on the behavior of the aircraft under the conditions prevailing at the time of the accident.

According to crew testimony, the aircraft was cruising at an altitude of 35,000 ft. on Mach 0.82, in straight and level flight; the autopilot was engaged and operating in the manual mode; altitude hold was "on" and the comparison unit was in operation. Under these conditions the pitch trim potentiometer irregularity would remain unnoticed and it would have no tendency to cause the aircraft to depart from the established cruise condition.

The rate switch of the vertical gyro transmitter was inoperative. Specifically, the rate gyro motor was found to have an open winding. The rate switch was, therefore, unable to respond to turns and would have permitted the erection system to remain on at all times. Normally, the rate switch deactivates the erection system during turns to prevent erection of the vertical gyro to a false (dynamic) vertical. However, during the slight turn and subsequent continuation of the straight flight path, this malfunction would not have manifested itself.

Tests of the comparison unit disclosed some irregularities in the pitchup attitude condition. One involved intermittent disengagement at a 10-deg. noseup attitude; however, this attitude is not pertinent to the level attitude of the aircraft in this instance. It was also slightly out of tolerance in response to a step change in pitchup attitude; however, this would have made it less sensitive and therefore less likely to disengage the autopilot in response to a pitchup of the aircraft.

These were the only discrepancies involving components capable through malfunctioning of causing the autopilot to alter the established flight condition or cause autopilot disengagement.

In analyzing the autopilot irregularities found, it is apparent that they were both minor in character and unable to have caused this disengagement. Although such disengagements are by no means common occurrences, some may be expected of an autopilot of this type incorporating a comparison monitor designed to disengage the autopilot quickly should it sense any number of undesirable behaviors or responses. In achieving the desired sensitivity of the monitor system it is conceivable that nuisance disengagements can occur as the result of transitory spurious signals. In this instance, the disengagement also could have been the result of either the accidental operation by the copilot of the stabilizer trim switch or the autopilot disconnect button, both of which are on the control wheel; or by operating the autopilot engage (on-off) switch located on the pedestal.

Functional tests performed on the Mach trim system disclosed that it was capable of normal operation. It must be concluded that it had not been turned on by the crew, otherwise it would have provided increasingly more noseup stabilizer trim action with increase in Mach number.

The crew reported a change in stabilizer trim to full nosedown. This did not result from a malfunction of the Mach trim system but could have resulted from inadvertent pressure upon the electric stabilizer trim switch located on the control wheel. Although Capt. Peters testified that he is quite certain his hand did not touch the switch it remains, after careful consideration, the only logical explanation for the trim system behavior. It is not definitely known what caused Capt. Lynch's electric stabilizer switch to not function when he attempted to use it after returning to his seat. It may have been caused by clutch slippage induced by high aerodynamic loads. In any event, it functioned in a normal manner when tested later.

It is evident that PAWA was lax in its inspection of the flight recorder and as a result allowed a shorter than normal tape to be used. This error resulted in the

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loss of valuable information because of improper recording.

The Board does not condone extended absences from the cockpit by crew members but recognizes that absences of short duration are sometimes necessary. The Board believes that during the absence of either pilot from the cockpit, the remaining pilot should devote his entire attention to flying the aircraft.

CONCLUSION

The Board concludes therefore that this accident resulted from the inattention of the copilot to the flight instruments during the captain's absence from the cockpit; that during this period the autopilot disengaged for reasons unknown, and that the copilot, unaware of this situation, permitted the aircraft to descend out of control.

As a result of this accident the company took the following corrective action:

1. Issued a directive that one pilot give continuous attention to the attitude and flight of the aircraft during autopilot operation.
2. Re-emphasized in pilot training the narrow speed margins between Mach 0.82 and M_{mo} and the brief interval of time it takes the aircraft to accelerate into critical speed ranges.

The Board determines that the probable cause of this accident was the inattention of the copilot to the progress of the flight, during the absence of the captain from the cockpit, following the involuntary disengagement of the autopilot. Contributing factors were the autopilot disengage warning light in the dim position and the Mach trim switch in the "off" position.

By the Civil Aeronautics Board:

James R. Durfee
Harmar D. Denny
G. Joseph Minetti

Chan Gurney vice chairman, did not take part in the adoption of this report.

The Civil Aeronautics Board was notified of this accident the morning of February 4, 1959. An investigation was immediately begun in accordance with the provisions of Section 701 (a) (2) of the Federal Aviation Act of 1958. Depositions of pertinent witnesses were taken in New York, N. Y., Mar. 11 and 12; in Seattle, Wash., Apr. 1; and in Los Angeles, Apr. 6 and 7, 1959.

Pan American World Airways, Inc., is a New York corporation with the main offices in New York, N. Y. The corporation operates as an air carrier under a certificate of public convenience and necessity issued by the Civil Aeronautics Board, and an air carrier operating certificate issued by the Federal Aviation Agency. These certificates authorize the carrier to engage in air transportation between various points in the United States and foreign countries, including the route involved in this instance.

Capt. W. Waldo Lynch, age 46, held a valid airman certificate with an airline transport rating and ratings for DC-3, DC-4, DC-6, DC-7, and B-707 aircraft. He had a total of 11,185 flying hours, of which 350 were in B-707 aircraft.

Copilot Samuel Peters, age 49, held a valid airman certificate with an airline transport rating, multi-engine land, and aircraft rating on the B-707 aircraft. He had a total of 14,952 flying hours, of which 269 were in B-707 aircraft.

Flight Engineer George Sinski, age 44, held a valid flight engineer certificate. He had approximately 11,012 hr., of which 194 were in B-707 aircraft. He was employed by the company Sept. 23, 1942.

Navigator John Laird, age 41, held a valid flight navigator certificate. He had a total of 1,376 hr., of which 211 were in B-707 aircraft. He was employed by the company May 13, 1946.

Pursers A. Leibner and R. Barton, and Stewardesses T. Clark, J. McCormack, J. Descoteaux, and P. Jones were all properly qualified.

N 712, a Boeing 707-121, serial number 17591, owned by Pan American World Airways, Inc., had a total of 705 flying hours. At the time of the accident it had accumulated 39 flying hours since the last maintenance phase check. The aircraft was powered by four Pratt & Whitney JT3C6 engines.

FAA Will Establish Medical Research Unit

Washington — Federal Aviation Agency plans to establish a Civil Aeromedical Research Center at FAA's Aeronautical Center, Will Rogers Field, Oklahoma City, under the direction of Civil Air Surgeon Dr. James L. Goddard.

The research center will be divided into five branches, three of which—Biophysics, Aviation Psychology and Environmental Physiology—will carry the burden of FAA's research work, including effects of aging on the proficiency of airmen and development of psychological tests to aid in the selection of air traffic controllers.

A fourth branch, Clinical Examinations, will perform detailed diagnostic medical evaluations of applicants for airmen medical certificates with physical conditions whose significance cannot be determined by standard medical examinations.

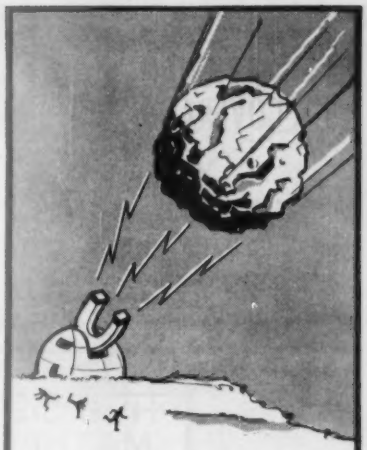
Britain Reports 120 Air Crashes in 1957

London—United Kingdom aircraft were involved in 120 accidents in 1957, according to the Ministry of Transport and Civil Aviation.

Eleven accidents occurred with public transport, of which seven were due to faulty operation or omissions by the crew, one to fatigue failure, one to powerplant failure and two to unidentified causes. Four of these were on scheduled passenger services.

Total of 104 passengers and 41 crew members died in the 16 accidents that were fatal. Twenty-two passengers and 22 crew members were injured.

Errors and omissions by crew members, many elementary, continue to cause a large proportion of accidents in all types of flying, the Ministry said.



It's a new transistorized magnetic control.

This one works . . but not the right way. Maybe you could lend us a hand in exchange for things like employee benefits and GPTL*

General Electric's **ARMAMENT AND CONTROL SECTION** in Johnson City (Binghamton) New York, has 14 openings for men with degrees and/or experience in mechanical engineering, electrical (electronics) engineering, mathematics and physics.

Some of the product areas include transistor and magnetic controls (none like the asteroid-pulling device illustrated), analog and digital computers. Career position openings include project leaders, technical writers, engineers in development, circuitry design, packaging, stress and vibration, systems, quality control and others.

General Electric has the right combination for developing your career potential. ***Good Place To Live (*ask the Chamber of Commerce*).**

MAIL COUPON TO:

Mr. R.C. McConnell, Div. E221-4
Armament and Control Section
General Electric Company
600 Main Street
Johnson City, New York

Send me more information. My job interest is.....

Name.....
Degree (year).....
Address.....
(Street or Route)
.....
(City) (Zone) (State)

☐ **My resume is enclosed.**

ARMAMENT AND CONTROL SECTION
GENERAL ELECTRIC
JOHNSON CITY, NEW YORK

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | **Civil Service Opportunities** | **Employment Agencies**
Positions Wanted | **Selling Opportunities Wanted** | **Employment Services**
Part Time Work | **Selling Opportunities Offered** | **Labor Bureaus**

DISPLAYED

The advertising rate is $45.00 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising Inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

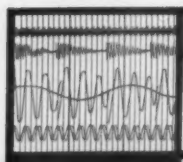
Subject to Agency Commission.

——RATES——

UNDISPLAYED

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted Ads are ½ of above rate.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.



Careers Unlimited for

PHYSICISTS, MATHEMATICIANS, and ELECTRONICS ENGINEERS

as

DATA PROCESSING SYSTEM SPECIALISTS

Missile flight testing and analysis is intriguing and rewarding! At Holloman Air Force Base, located on the White Sands Missile Range, Telecomputing Services, Inc. is daily associated with this fascinating business.

We are an essential part of the exciting business of flight testing the latest types of missiles. Our job is the rapid computation of complete and accurate reports on missile performance.

We work with the latest measuring and processing equipment — cinetheodolites, precision radars, telemetry systems, recording telescopes, and electronic data conversion equipment.

These positions require men with vision and initiative. Physicists and Mathematicians are needed to work with high speed digital computers and other data reduction equipment to reduce, analyze, evaluate and report to the military and contractors, flight test results gathered from various range instrumentations.

Outstanding graduate electronics engineers with a background in solid state, digital logic, and analog circuitry are offered an opportunity to indulge in the pride and professional stature that results only from programs personally conceived, developed, and guided from conception to final application.

In addition to our pleasant, modern facility and professional working atmosphere, other benefits include:

• *Profit Sharing* • *Area Bonus* • *Competitive Salaries*
• *Relocation Pay* • *Educational Reimbursement*

For Application and Further Information, write:
Director of Technical Personnel

TELECOMPUTING SERVICES, INC.
SUBSIDIARY OF
TELECOMPUTING CORPORATION
BOX 447-B, HOLLOMAN AIR FORCE BASE, NEW MEXICO

FLORIDA OPENINGS

FOR

AIRCRAFT DESIGNERS
STRESS ANALYSTS

A PROGRESSIVE RESEARCH AND DEVELOPMENT GROUP HAS OPENINGS FOR ENGINEERS EXPERIENCED IN AIRCRAFT DESIGN, AIRCRAFT SYSTEMS AND STRESS ANALYSIS. IF YOU HAVE A DEGREE IN AERONAUTICAL, CIVIL OR MECHANICAL ENGINEERING, OR ARE A GRADUATE OF A TECHNICAL SCHOOL WRITE FOR FURTHER INFORMATION AND TO ARRANGE AN INTERVIEW TO

P-2946, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. BOX 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITIONS VACANT

Aircraft Radio Technician. Fastest growing Electronics Shop in the East requires more trained technicians for fine job opportunities in the business aircraft radio field. Excellent working conditions. Flight Electronics Corporation, Westchester County Airport, White Plains, N. Y. Rockwell 1-1150.

Wanted: Man capable of managing Radio Shop. Must be experienced in design and installation of communication, navigation, radar and autopilot systems in large multi-engined executive aircraft. Attractive proposition to qualified man. Executive Aircraft Service, Inc., Redbird Airport, Dallas 33, Texas. FEderal 1-6558.

POSITIONS WANTED

An aviation executive who can fly! Ex-airline pilot, flight instructor, and Air Force flight engineer with 8 years advertising experience. Proficient in art, production, copy, and account handling. Looking for a spot to use both sides of my background. Wm. B. Nelson, 1116 Chelsea Ave., Santa Monica, Calif.

Chemical Engineer: M.S. Age 33. Member of Tau Beta Pi and Sigma Xi. Ten years of experience mostly in high temperature inorganic chemistry and refractory metallurgical research. Experience includes management and technical-economic evaluations of research problems. Desires a more responsible position in research or development. Minimum salary $14,000. PW-2968, Aviation Week.

Presently employed airline capt. desires position as exec. pilot. PW-3019, Aviation Week.

Helicopter pilot desires permanent change. 4,000 helicopter hours, college degree, age 35, desire flying position, foreign or domestic. PW-3044, Aviation Week.

Versatile individual, licensed ATR Pilot, Flight Engineer and Navigator with over 11,500 hours flying experience, no accidents. Proficient in international and domestic flight procedures, thoroughly qualified in Middle East and North Africa areas. Rated in DC-3, DC-4, Convair 240, in DC-3 and lighter aircraft. Currently qualified as flight engineer in Boeing Stratocruiser. Licensed Navigator with Atlantic and Pacific experience. Interested in a flying position with definite possibilities for the future, currently employed. PW-3056, Aviation Week.

Sales Engineer. Familiar all West Coast aircraft, missile, major component manufacturers. Presently located San Francisco Bay area. Graduate M. E. Available thirty days. PW-3053, Aviation Week.

BUSINESS OPPORTUNITY

Helicopter Dry Lease Contracts available to qualified helicopter pilots in Southeast. Low hourly rental includes parts and major maintenance. Excellent references required. BO-2945, Aviation Week.

FOR SALE

680 Aero Commander TTA 1111 hrs., engines 333/215 Complete radio and L2 Autopilot. Dual Hyd. system and De-Icer equipment. Will sell or trade down for new or late model Bonanza. FS-3012, Aviation Week.

WE'RE LOOKING FOR A MAN LIKE Boyle

$\frac{V}{V^1} = \frac{P^1}{P}$

—WITH A MODERN TURN OF MIND

For much of what we know of the atmosphere about the earth, we can thank men like Boyle.

His achievements of centuries ago may help launch the space conquests of tomorrow.

But much remains to be done—and quickly.

Today, at Goodyear Aircraft, highly efficient nose cones are just one product of the keen minds forging tools for probing the mysteries of the firmament.*

If you're a young man with the tenacity of a Boyle—and a measure of his genius—we'd like to have you around. The benefits to us both—and to mankind—could be substantial.

Write: Mr. Charles Jones, Director of Technical and Scientific Personnel, Goodyear Aircraft Corporation, Akron 15, Ohio.

**Programs in rocket propulsion, interplanetary guidance, advanced black boxes, crew escape capsules—also in ground support systems for missiles, radar structures, radomes, radiation research, structures engineering.*

GOODYEAR AIRCRAFT

Engineers

At Norden Laboratories... there's more than *talk* about Advanced Programs, there are challenging *complex* problems being solved regularly...

OUR WIDELY diversified programs in advanced areas require men with solid engineering backgrounds who by employing a sound business approach, can get a job done. Norden is an "engineers' company." Here you can work with modern equipment on many important projects. You will be associated with top men in the precision electronics field and have available a strong force of support personnel. Norden's management knows and appreciates good engineering and understands the problems engineers face working in complex areas.

There are career openings at two fine locations— White Plains, New York and Stamford, Connecticut— for capable, creative men at all levels of experience:

Section Heads
MICROWAVE & ANTENNA
AIRBORNE RADAR RECEIVER
SONAR DEVELOPMENT

Project Engineers
INERTIAL PLATFORMS
MILITARY TELEVISION
GROUND SUPPORT & TEST EQUIPMENT
RADAR & INDICATOR DISPLAYS

Systems Engineers
RADAR & TELEVISION
FIRE CONTROL • NAVIGATION
SYNTHESIS & ANALYSIS
GUIDANCE & CONTROL
ASW SYSTEMS • SERVO ANALYSIS

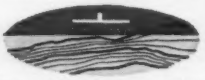
Circuit Development Engineers
VIDEO & CRT DISPLAYS
RADAR TRANSMITTERS AND RECEIVERS
TRANSISTOR PULSE CIRCUITRY

Equipment Design Engineers
MISSILE & AIRBORNE TELEVISION
AIRBORNE RADAR & FIRE CONTROL
ADVANCED PRINTED CIRCUITS
MICROMINIATURE ELECTRONICS

Quality Assurance Engineers
RELIABILITY • STANDARDS
ENVIRONMENTAL TEST
COMPONENT EVALUATION

These are some of the advanced programs now under way:

AN/ASB-7 Bomb-Nav System



3-Dimensional Terrain Presentation for Low-Flying Aircraft

Meteorological Radar

Automatic Tracking TV Theodolites

Inertial Navigation Systems

▶ SATURDAY & EVENING INTERVIEWS ARRANGED ◀

Send resume to:
Technical Employment Manager

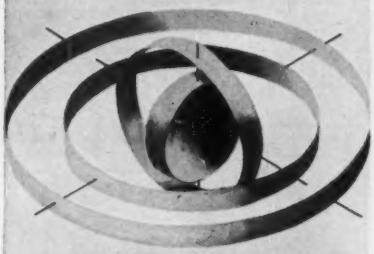
NORDEN LABORATORIES

NORDEN DIVISION OF UNITED AIRCRAFT CORPORATION
121 Westmoreland Avenue – White Plains, New York

Within driving distance of entire New York – New Jersey Metropolitan area
White Plains, New York Stamford, Connecticut

EE, ME, PHYSICIST

AN OUTSTANDING OPPORTUNITY FOR A SPECIALIST IN PRECISION ENGINEERING OF



INERTIAL COMPONENTS

WITH GENERAL ELECTRIC

The Ordnance Department of General Electric in Pittsfield, Massachusetts holds a sizable number of contracts for the D&D of advanced missile navigation and guidance systems and subsystems for major missiles. In this area there is an excellent opportunity for an engineer with 8-10 years experience in design, development, test and evaluation of gyros and accelerometers.

This engineer will work in an atmosphere of intellectual and creative enthusiasm with colleagues who have won professional recognition for their know-how in the inertial field. Engineer-management encourages initiative and responsibility. Stimulating contacts with M.I.T. and General Electric Laboratories are part of product design assignments.

Location is in the heart of the beautiful Berkshires, well known for its skiing in the winter and music and dance festivals in the summer.

Please contact specifying salary requirements:
Mr. R. G. O'Brien, Div. 64WT
ORDNANCE DEPARTMENT
Of the Defense Electronics Div.

GENERAL ELECTRIC
100 Plastics Ave., Pittsfield, Mass.

Operations Research Scientists:

Need time to develop your ideas?

Most scientists engaged in operations research work seem to feel that they cannot do their most productive work when they are constantly fighting unrealistic deadlines.

The operations research programs at System Development Corporation are carefully planned to provide ample time for the development of new ideas that apply to the development of large-scale, computer-based information-processing systems.

The following are just a few examples of the areas in which Operations Research Scientists work at SDC: (1) simulation and operations gaming techniques in problems of control systems; (2) mathematical logic applied to universal computer languages; (3) medical data processing; (4) stochastic modeling of man-machine interactions; (5) logistics; (6) test design for operational computer programs.

Operations Research positions are now open for scientists at several levels of experience. Please send your inquiry to Mr. E. A. Shaw, SDC, 2404 Colorado Avenue, Santa Monica, Calif.

"Application of Computer Simulation to Production System Design," a paper by Allen J. Rowe, is available upon request. Send request to Dr. Rowe at SDC.

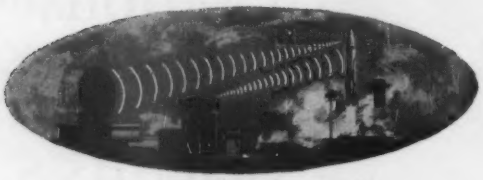
SDC

SYSTEM DEVELOPMENT CORPORATION

Santa Monica, California • Lodi, New Jersey

Interested in Systems Engineering?

There are systems



...and systems

...and TOTAL systems in which the big bird and support equipment may rank only as a component.

This difference between systems can make a big difference in your career

IF YOU ARE QUALIFIED and interested in contributing to programs of "total" scope, it will be of value to you to investigate current opportunities with General Electric's DEFENSE SYSTEMS DEPT., whose work lies primarily in providing *total* solutions to large scale defense problems of the next 5, 10 and 20 years.

The work here lies almost entirely in the areas of systems engineering and systems management.

Inquire about these positions:

- Guidance Equation Engineers
- Systems Logistics Engineers
- Electronic Systems Management Engineers
- Operations Analysis Engineers
- Systems Program Engineers
- Data Processing Engineers
- Systems Test Evaluation Engineers
- Engineering Psychologists
- Radar Equipment Engineers
- Weapons Analysis Engineers
- Weapons Systems Integration Engineers
- Engineering Writers

Forward your confidential resume at an early date.

Whereas the growth potential is evident – both for DSD and the engineers who join us – the positions we fill during these early months will carry significant "ground-floor" benefits.

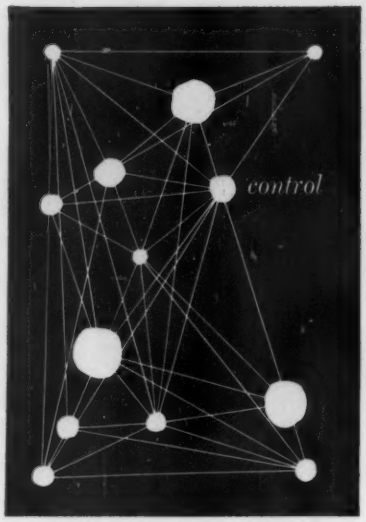
Write fully to Mr. E. A. Smith, Room 11-B

DSD DEFENSE SYSTEMS DEPARTMENT

A Department of the Defense Electronics Division

GENERAL ELECTRIC

300 South Geddes Street, Syracuse, N. Y.



careers in control of space

For 74 years, Minneapolis Honeywell has pioneered and led the development and production of advanced automatic controls. Today, with work in this area more demanding and more rewarding, new opportunities exist for engineers.

PRODUCTION: Develop and establish assembly processes for a wide range of products. Requires background in complex devices such as gyros, accelerometers, flight systems, and a thorough knowledge of production processes.

EVALUATION: Test engineer interested in career in development, qualification, reliability testing. Must be graduate engineer with electronic background.

ADVANCED GYRO DESIGN: Engineers with two and up to twenty years' experience in such areas as precision gyro mechanics, servo techniques, digital data handling, electronics packaging, advanced instrumentation and magnetic components design.

FLIGHT CONTROL SYSTEMS: Analytical, systems, component engineers to design and develop advanced flight reference and guidance systems. Prefer airborne systems or servo experience.

FIELD SERVICE: Monitor airborne system performance in U.S. and overseas. Conduct training, liaison with military. BSEE preferred, or graduate engineer with high electronic aptitude.

GROUND SUPPORT: Senior engineers with logical design experience and engineers with experience in ground support or related areas. Outstanding growth opportunity in new division.

If you're interested in a challenging career in advanced automatic controls, write Mr. Bruce D. Wood, Technical Director, Dept. 66G.

Honeywell H HONEYWELL

AERONAUTICAL DIVISION

1433 Stinson Blvd., N.E., Minneapolis 13, Minn.

To explore professional opportunities in other Honeywell operations coast to coast, send your application in confidence to H. D. Eckstrom, Honeywell, Minneapolis 8, Minnesota.

ENGINEERS • SCIENTISTS

THE MITRE CORPORATION

OFFERS BROAD PROFESSIONAL PARTICIPATION

in Large-Scale System Engineering

The growing complexity of our technology has created an acute demand for large-scale, computer-based systems. This demand is being met in the vital area of air defense at The MITRE Corporation. Formed under the sponsorship of the Massachusetts Institute of Technology, MITRE is applying the skills of its growing Professional Staff to the definition and solution of the varied and complex problems inherent in the design and development of large-scale, computerized systems operating in real time.

Utilizing a multi-discipline approach that takes cognizance of the immediate and long-term threat, the total defense posture – both present and projected – and the logistics of air defense, it is MITRE's responsibility to design and develop the best possible defense system, at minimum cost, for any given time period. In addition to this continuing task MITRE has undertaken several secondary objectives related to air defense and air traffic control.

Immediate Professional Staff appointments are available for individuals with qualifications prerequisite to making significant individual contributions in these areas:

- **SYSTEM DESIGN**
- **COMPONENT RESEARCH and DEVELOPMENT**
- **REAL-TIME COMPUTER CONTROL SYSTEMS**
- **RADAR SYSTEMS**
- **OPERATIONS ANALYSIS**
- **WEAPONS SYSTEM INTEGRATION**
- **HUMAN ENGINEERING**
- **COMMUNICATIONS SYSTEMS**
- **ELECTRONIC WARFARE**
- **INTEGRATED SYSTEM EVALUATION**
- **LOGISTICS – SYSTEMS PHASING**

These positions are available at MITRE's modern facilities in suburban Boston, Massachusetts, Fort Walton Beach, Florida and Montgomery, Alabama.

• • • • • • • • • •

To arrange for an immediate confidential interview, send resume to Dana N. Burdette, Personnel Director.

THE MITRE CORPORATION

244 Wood Street – Lexington 73, Massachusetts

AEROSPACE

ENGINEERS—SCIENTISTS

...Long Range EXPANSION

Beechcraft is a company where the past and the present PROVE the future is interesting and worthwhile. This is your opportunity to join an engineering team where:

LEADERSHIP in engineering design and the production of business airplanes and ground support equipment is a world-famous Beechcraft specialty.

DIVERSIFICATION of production contracts has created a diversity of creative opportunities and employment stability at Beechcraft.

COMPETITIVE SUCCESS has been proved with Beechcraft's winning of the Mach 3 Alert Pod Design and Mach 2 Missile-Target awards.

A LONG RANGE EXPANSION PROGRAM is in progress and Beech Aircraft has responsible positions open now on advanced super-sonic aircraft and missile-target projects in the following aerospace fields:

ELECTRONICS
(Antenna, Telemetry or Circuitry Design)

INFRA-RED

AUTO PILOT

MISSILE SYSTEMS

RELIABILITY
(Mech., Airframe or Power Plant)

ANALOGUE COMPUTER

DYNAMICS
(Flutter)

AERODYNAMICISTS

AERO-THERMODYNAMICISTS
(Heat Transfer)

DESIGN
(GSE, Airframe, Power Plant and Instillations or Mechanical)

For more information about a company with a long range future where your talents will build your own future — call collect or write today to D. E. BURLEIGH, Chief Administrative Engineer, or C. R. Jones, Employment Manager, Beech Aircraft Corporation, Wichita, Kansas.

All Expenses Paid for Interview Trip

Beechcraft

Wichita, Kansas Boulder, Colorado

LENKURT

has opportunities for

- Communications Engineers
- Development Engineers
- Sales Engineers
- Asst. Electrical Engineers
- Engineering Writers

Live and work on the Beautiful San Francisco Peninsula!

Please call collect
LYtel 1-8461

or send resume to:

E. Jack Shannahan
Employment Manager

LENKURT
ELECTRIC CO., Inc.
1105 County Road
San Carlos, California

AIRCRAFT EQUIPMENT

SALES ENGINEER

Diversified corporation in Fairfield County, Conn., has opening in aircraft equipment division for qualified sales engineer to cover New England, Long Island and Metropolitan New York area. Experience with electro-mechanical, pneumatic and hydraulic aircraft equipment necessary.

P-3049, Aviation Week
Class. Adv. Div.,
P. O. Box 12, N. Y. 36, N. Y.

When Answering
BOX NUMBERS . . .

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

FOR ADDITIONAL INFORMATION

About Classified Advertising,

Contact The McGraw-Hill Office Nearest You.

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JAckson 3-6951
R. POWELL

BOSTON, 16—350 Park Square
HUbbard 2-7160
M. J. HOSMER

CHICAGO, 11
520 No. Michigan Ave.
MOhawk 4-5800
W. HIGGENS—E. S. MOORE

CLEVELAND, 13
1164 Illuminating Bldg.
SUperior 1-7000
W. B. SULLIVAN—T. H. HUNTER

DALLAS, 2—1712 Commerce St.
Vaughan Bldg.
RIverside 7-5117
GORDON JONES—F. E. HOLLAND

DETROIT, 26—856 Penobscot Bldg.
WOodward 2-1793
J. R. PIERCE

LOS ANGELES, 17—1125 W. 6th St.
HUntley 2-5450
C. YOCOM

NEW YORK, 36—500 Fifth Ave.
OXford 5-5959
H. T. BUCHANAN—R. P. LAWLESS
T. W. BENDER

PHILADELPHIA, 3
Six Penn Center Plaza
LOcust 8-4330
H. W. BOZARTH

ST. LOUIS, 8—3615 Olive St.
JEfferson 5-4867

SAN FRANCISCO, 4—68 Post St.
DOuglas 2-4600
S. HUBBARD

careers grow at Link Aviation

Link has grown to be one of the world's largest producers of analog computing equipment, from its start as the pioneer (and now leading producer) of electronic flight simulators.

And your career will grow with Link Aviation, Inc., in Binghamton, New York. These and other opportunities are available now!

Advanced circuit development

ASW/AEW systems simulation

Fire control computer design

Radar simulation

Analog & digital computer components & systems

Aircraft simulation

Optical systems development

Note your engineering degree (or equivalent) and previous experience in your reply and write immediately to:
Mr. A. P. Darrah
Link Aviation, Inc.
Binghamton, New York

LINK — A GENERAL PRECISION COMPANY

A subsidiary of General Precision Equipment Corporation

a significant NEW program at

UNITED AIRCRAFT..

WEATHER OBSERVING AND FORECASTING SYSTEM 433L

Weather Observing and Forecasting System 433L is an integrated semi-automatic electronic system being developed under a joint Federal Aviation Agency — Department of Defense — Department of Commerce agreement to observe, collect, process, disseminate and display weather information.

the areas of activity

include weather observing, data handling, and communications, weather forecasting, computer programming, and display and presentation. New techniques and equipment are being developed for observing airfield weather conditions, obtaining vertical soundings of the atmosphere, and detecting clouds, precipitation, and severe weather.

Criteria for operational suitability of data processing and forecasting methods using large-scale digital computers are being devised.

A high-speed communications system will permit rapid collection and transmission of weather data. Also under development are equipments for the display of raw and processed weather information for operational use by meteorologists, pilots, and other users.

the role of UNITED AIRCRAFT

is that of System Integration Contractor. As such United Aircraft Corporation serves as a prime agency to assist the U. S. Government to obtain a highly effective weather observing and forecasting system. In addition to its management team, United Aircraft furnishes a Data Processing Center, training facilities, and operational analysis, and will operate and manage weather station test facilities.

the program presents opportunities in . . .

- **computer programming**
- **operations analysis**
- **weather station management**
- **technical specifications**

also selective positions available in . . .

- **communications • digital systems • radar • displays**
- **technical writing**

reply to: W. M. WALSH personnel assistant

WEATHER SYSTEM CENTER

UNITED AIRCRAFT CORPORATION

432 MAIN STREET

EAST HARTFORD · CONNECTICUT

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE:

The advertising rate is $31.00 per inch for all advertising appearing on other than on contract basis. Contract rates on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

FOR SALE

SPARE PARTS INVENTORY

C-46—DC-4—DC-6

AIRCRAFT

also

PRATT & WHITNEY

R2800 CB16/17 ENGINES

THE FLYING TIGER LINE INC.

Burbank, Calif.

Call or Cable

Doug Duly

Tel: TRiangle 7-3411 Cable: Flytiger

CONVAIR 340/440

Airline Interior, will convert to suit
Zero engines, props.
Major airframe inspection
We own this aircraft

LUND AVIATION (Canada) LTD.

Montreal Airport
Phone MElrose 1-3519

HILLER HELICOPTER

Modernized UH12B with complete agricultural spray equipment. Attractively priced. Low time.

EAST COAST AVIATION CORPORATION

Lexington 73, Massachusetts

E-50 TWIN BONANZA

ORIGINAL OWNER

Completely equipped with radio, instruments, autopilot and extras. Best maintenance. 1030 T.T., 330 S.M.O.H. on B-1 and B-6 engines. Available now. $42,500

CONTACT: CHIEF PILOT.

BRUNNER AND LAY INC.

9300 King St., Franklin Park, Illinois
Gladstone 5-3232

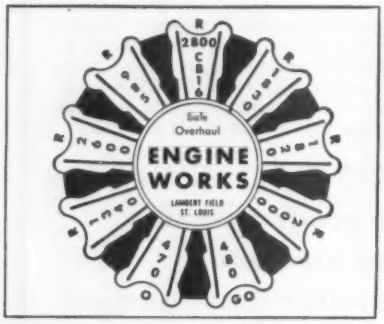
OFFICIAL PROPOSALS

Bids: November 23, 1959

Airport Operator
for
Brainard Field
Hartford, Conn.

Proposals will be received in the Department of Aeronautics Building, Brainard Field, Hartford, Connecticut, until 2.30 P.M. E.S.T. on November 23, 1959, and then publicly opened for the fixed-base operation, land-leasing and provisions of required services and facilities at Brainard Field, Hartford, Connecticut. Said proposals shall be subject to the conditions and specifications contained in "Instructions to Applicants" and shall be filed on proposal forms, both of which may be procured at the Department of Aeronautics Building, Brainard Field, Hartford, Connecticut.

The Connecticut Aeronautics Commission reserves the right to waive any informality in the proposals, to negotiate further with the applicant who most closely meets the objectives of said Commission and to reject any and all proposals.



WANTED

twin engine aircraft

OUR TERMS-**CASH**

We are not brokers

GRAUBART AVIATION, INC.

Mohawk 4-6260

PRUDENTIAL PLAZA CHICAGO, ILL.

"SEARCHLIGHT"

IS

Opportunity Advertising

—to help you get what you want—to help you sell what you no longer need.

Take Advantage Of It

For Every Business Want

"Think Searchlight First"

WANTED

Executive Learstar

Super Ventura or Similar Type

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LETTERS

HU2K-1 Clarification

Needless to say, we were very much pleased with Bill Burke's article "Kaman Goes to Single Rotor for HU2K-1" (AW Oct. 26, p. 92). It was a thorough, accurate, and very fair piece of writing, in our opinion.

However, there are two points that I believe we should clarify. One is that I am sure Bill did not mean to convey an impression that some readers might have gathered. Kaman Aircraft has not, by any means, abandoned the synchropter or intermeshing rotor configuration. We believe that each of the rotor configurations has particular advantage, and that it is our job as designers and manufacturers to choose the rotor arrangement that is best suited to the requirements. The Navy's search, rescue and utility mission requires high speed and long range. In the Navy's opinion, and in ours, this is best achieved by the single rotor helicopter. The Air Force, on the other hand, for its local base crash rescue mission was looking for high lift, maneuverability and ability to land in confined areas. These, plus ability to hover tail into the wind, are unique advantages of the H-43 synchropter design (AW Dec. 22, 1958, p. 71).

As new requirements arise, it is our duty as designers to choose the rotor arrangement that does the job best, whether it be synchropter, single tandem, coaxial or quadrirotor.

I am sure that Bill Burke understood this and it was in his mind to convey it by what he wrote, but I wanted to make certain that the record was absolutely straight. We think single rotor helicopters are great. We think synchropters are great. The configuration selected for a particular helicopter depends on what you want it to do.

Second, you are correct in quoting Admiral Booth that the Navy does not yet have active plans for the HU2K in an anti-submarine role. However, the extension of the paragraph (not attributed to the admiral) says that the HU2K lacks the capacity to carry attack weapons. The statement is not correct. Exact performance is still classified, but the HU2K does have the payload capacity to carry attack weapons in addition to detection gear with a significantly useful search endurance. This combined with its capability to operate in conjunction with existing destroyer forces from many types of ships other than aircraft carriers offers the fleet a new potential in anti-submarine warfare.

Many thanks again.

Charles H. Kaman, President
The Kaman Aircraft Corp.
Bloomfield, Conn.

Beech 65 Reports

Our compliments to Aviation Week and especially to writers Erwin J. Bulban and Herbert J. Coleman for the excellent handling of the magazine's comprehensive two-part report on our new Beechcraft Model 65 Queen Air executive transport (AW Oct. 26).

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

As presented, the material reflects a high level of technical experience and product knowledge attainable only through extensive personal investigation, astute observation and careful evaluation. Both articles—Mr. Bulban's engineering design analysis (p. 132) and Mr. Coleman's pilot report (p. 144)—were very thorough, factual and well written. In short, we were very pleased with the over-all treatment of subject matter and accompanying illustrations.

It is always a pleasure to work with people who know what they are talking about.

James R. Greenwood
Supervisor, News Bureau & Publications
Public Relations Department
Beech Aircraft Corp.
Wichita, Kan.

SC.1 Demonstration

Your story on our SC.1's first public demonstration made good reading (AW Oct. 12, p. 84), but we would like to correct two points. We have thought (a lot) about recirculation and ingestion of foreign objects including grass. We had already hovered successfully over grass—what we hadn't thought about was that the Farnborough runway edge grass had been freshly mown and left down.

Another small correction relates to the landing gear. The two-position main wheel feature is included to shift the main wheels well back with respect to the center of gravity for hovering landings which we felt might involve backward drift—hence the castering of all wheels.

H. G. Conway
Director & Chief Engineer
Short Brothers & Harland Limited
Belfast, Ireland

Poet's Corner

In your issue for Oct. 5 (p. 184), you have another of your perennial tilts at Perfidious Albion's pet windmill, the Farnborough air display, by republishing a letter that originally appeared in London's "Flight" magazine.

Well, as you seem to have exhausted (wrung dry?) the ALPA-jet-crew-member-to-be-or-not-to-be Letters dirge, at least to the extent of publishing a secondhand British letter, why not give your cash customers a real treat? At no extra charge than the modest fee of you telling your readers it has on one occasion dropped a parapack weighing 29,000 lb. and has a published gross of 143,000 lb. (max.), but cruises at about 180 mph. at 8,000 ft. on four 2,850 hp. Bristol Centaurus radials: I give you the Blackburn Beverley of Royal Air Force Transport Command. You've read Masefield's epic ". . . dirty British coaster . . ."; well, here's "AND THE BEV. SHE WAS CREATED"

(For the meter, try Longfellow's "By the Waters . . .", or Shorthouse's drinking lament ("I give my all . . ."):

Near the factory owned by Blackburns,
  By the water of the Humber,
Was a small decrepit airfield
  Filled with junk, and filled with lumber.
"Waste not, want not," laughed the Boss-
    man,
  "Nobody will ever buy it;
"Let us fit it altogether,
  "Bet the 'RAF' will have to fly it!"
So they started work in earnest,
  All with hacksaws madly cutting.
Bits of lorry, bits of fencing,
  Bits of barn and Nissen hutting.
Thus a structure was created,
  Roughly nailed and tied together;
Covered o'er with Nissen hutting
  To keep out the winter weather.
Antique wheels from antique tractor,
  All were fastened by a clamper
Underneath the metal mountain
  Just before the bogey damper.
In each engine cowling snugly,
  Firmly held by special fixer,
Was a shining power unit
  Special modded concrete mixer.
When they ran the mighty motors
  All the 'craft was madly quaking;
Some were pulling, some were pushing,
  They'd discover'd airscrew braking.
So beware you budding Birdmen,
  Lest you drop an awful clanger;
Don't fly Blackburn's pet abortion,
  Better try to fly the hangar!

Bet our friends in MATS haven't anything quite like this?

Duncan Bevan
Wroughton House Rowing Club
Battersea-on-Thames, England

Tu-114 Takeoff

Read with interest the editorial "Aeroflot Visits U.S." in the Oct. 5 issue of Aviation Week; however, one point has remained a mystery to me and several of my associates. You used the term "unstuck" when describing the departure of Khrushchev from Andrews Air Force Base. Could you please explain this terminology and the significance of no one ever forgetting the sight.

I assumed that becoming "unstuck" at 8,700 ft. on a 9,000 ft. runway was not good, but since your article had been complimentary on the Tu-114 up to that time I was not sure what you were implying.

Thanking you in advance for your prompt attention to this matter.

Billy C. Menges
Editorial Department
Allegany Ballistics Laboratory
Hercules Powder Co.
Cumberland, Md.

(The sight of a turboprop aircraft grossing 367,000 lb. making a run of 8,700 ft. down a 9,000 ft. runway before becoming unstuck, or airborne, would be unforgettable, since only 300 ft. of runway remained—not much of a safety margin.—Ed.)

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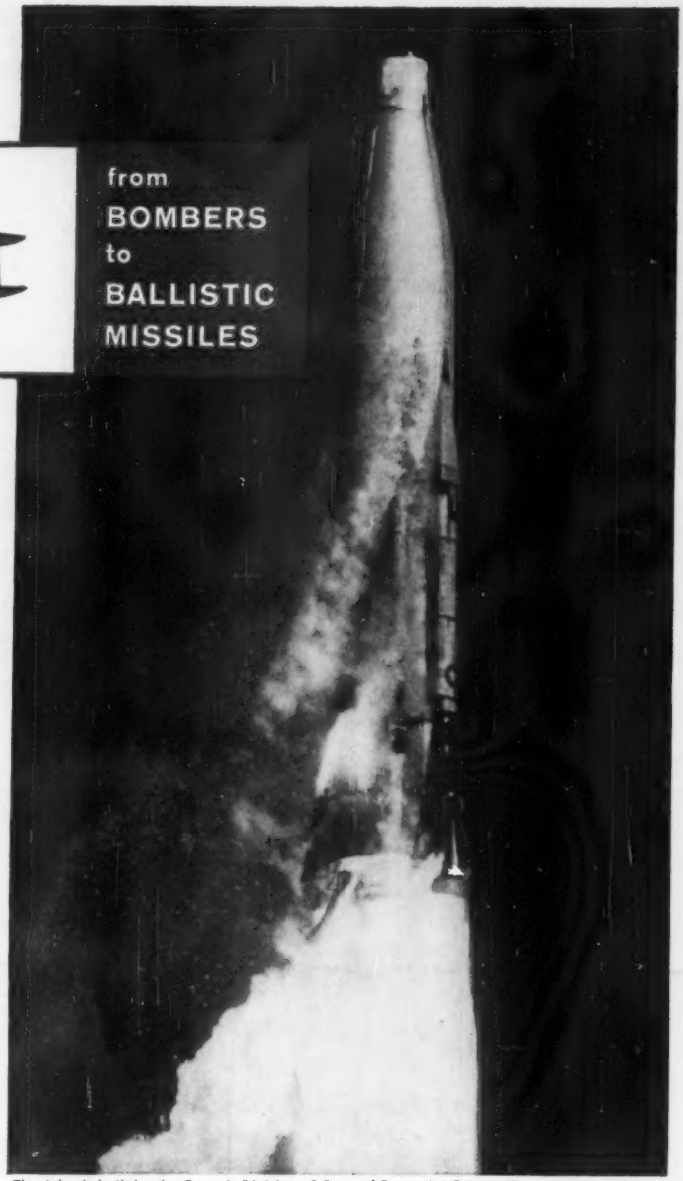

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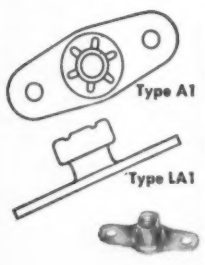

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